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HUXLEY ON EDUCATION[1]

The stars come nightly to the sky;
The tidal wave comes to the sea;
Nor time, nor space, nor deep, nor high
Can keep my own away from me.
—BURROUGHS.

THE most sanguine day of the college year is the opening one: the student has not yet faced the impossible task annually presented of embracing the modern world of knowledge; his errors and failures of earlier years are forgotten; he faces the coming months full of new hope.

How would my old master, Huxley, address you if he were to find you in this felicitous frame of mind, sharpening your wits and your pencils for the contest which will begin to-morrow morning in every hall and laboratory of this great university? May I speak for him as I heard him during the winter of 1879–80 from his lecture desk and as he kindly in conversation gave me of his stores of wisdom and experience? May I add from his truly brilliant essays entitled "Science and Education," delivered between 1874 and 1887? May I contribute also from my own thirty-seven years of life as a student and teacher, beginning in 1873 and reaching a turning point in 1910 when Columbia enrolled me among its research professors? It was Huxley's life, his example, the tone of his writings rather than his actual precepts, which most influenced me, for in 1879 he was so intensely absorbed in public work and administration, as well as in research and teaching, that little opportunity remained for personal conferences with his

[1] Address at the opening of the college year, Columbia University, September 28, 1910.

students. How I happened to go to him was as follows:

Unlucky—as they appeared to me at the time, but lucky as I look back upon them—were my own early flounderings and blunderings in seeking the true method of education. Huxley has observed of his "Voyage of the *Rattlesnake*" that it is a good thing to get down to the bare bones of existence. The same is true of self-education. As compared with the hosts of to-day, few men in 1877 knew how to guide the graduate youth; the Johns Hopkins was still nascent; the creative force of Louis Agassiz had spent itself in producing the first school of naturalists, including the brilliant William James. One learned one's errors through falling into pitfalls. With two companions I was guided by a sort of blind instinct to feel that the most important thing in life was to make a discovery of some kind. On consulting one of our most forceful and genial professors his advice was negative and discouraging: "Young men," he said, "go on with your studies for ten or twelve years until you have covered the whole subject; you will then be ready for research of your own." There appeared to be something wrong about this, although we did not know exactly what. We disregarded the advice, left the laboratory of this professor, and at the end of the year did succeed in writing a paper which subsequently attracted the attention of Huxley and was the indirect means of an introduction to Darwin. It was a lame product, but it was ours, and in looking back upon it, one feels Touchstone's comment upon Audrey:

> A poor virgin, Sir,
> An ill favored thing, Sir,
> But mine own.

I shall present in this brief address only one idea, namely, the lesson of Huxley's life and the result of my own experience is that *productive thinking* is the chief *means* as well as the chief *end* of education, and that the natural evolution of education will be to develop this kind of thought earlier and earlier in the life of the student.

One of the most marvelous of the manifold laws of evolution is what is called "*acceleration.*" By this law the beginning of an important organ like the eye of the chick, for example, is thrust forward into a very early stage of embryonic development. This is, first, because the eye is a very complex organ and needs a long time for development, and second because the fully formed eye of most animals is needed immediately at birth. I predict that the analogy in the evolution of education will be very close. Productive thinking may be compared to the eye; it is needed by the student the moment he graduates, or is hatched so to speak; it is now developed only in the graduate schools; it is such an integral and essential part of education that the spirit of it is destined to be "accelerated," or thrust forward into the opening and preparatory years.

If the lines of one's life were to be cast afresh, if by some metempsychosis one were moulded into what is known as a "great educator," a man of conventions and platforms, and were suddenly to become more or less responsible for 3,000 minds and souls, productive thinking, or the "centrifugal method" of teaching would not be postponed to graduation or thereafter, but would begin with the freshman, yes, among these humble men of low estate! It may be *apropos* to recall a story told of President McCosh, of Princeton, a man who inspired all his students to production and enlivened them with a constant flow of humor. On one occasion he invited his predecessor, ex-President McLean, to offer prayers in the college chapel. Dr. Mc-

Lean's prayer was at once all embracing and reminiscent; it descended from the foreign powers to the heads of the United States government, to the state of New Jersey, through the trustees, the faculty, and, in a perfectly logical manner, finally reached the entering class. This naturally raised a great disturbance among the sophomores, who were evidently jealous of the divine blessing. The disturbance brought the prayer to an abrupt close, and Dr. McCosh was heard to remark: "I should think that Dr. McLean would have more sense than to pray for the freshmen."

As regards the material into which "productive thinking" is to be instilled, I am an optimist. I do not belong to the "despair school" of educators, and have no sympathy with the army of editorial writers and prigs who are depreciating the American student. The chief trouble lies not with our youth, nor with our schools, but with our adults. How can springs rise higher than their sources? On the whole, you students are very much above the average American. You are not driven to these doors; certainly in these days of youthful freedom and individualism you came of your own free will. The very fact of your coming raises you above the general level, and while you are here you will be living in a world of ideas—the only kind of a world at all worth living in. You are temporarily cut off more or less from the world of dollars and cents, shillings and pence. Here Huxley helps you in extolling the sheer sense of joy in thinking truer and straighter than others, a kind of superiority which does not mean conceit, the possession of something which is denied the man in the street. You redound with original impulses and creative energy, which must find expression somehow or somewhere; if not under the prevailing incurrent, or "centripetal system" of academic instruction, it must let itself out in extra-academic activities, in your sports, your societies, your committees, your organizations, your dramatics, all good things and having the highest educational value in so far as they represent your output, your outflow, your centrifugal force.

You are, in fact, in a contest with your intellectual environment outside of these walls. Morally, according to Ferrero, politically, according to Bryce, and economically, according to Carnegie, you are in the midst of a "triumphant democracy." But in the world of ideas such as sways Italy, Germany, England, and in the highest degree France, you are in the midst of a "triumphant mediocrity." Paris is a city where "ideas" are at a premium and money values count for very little in public estimation. The whole public waits breathless upon the production of "Chanticleer." That Walhalla of French ambition, "la Gloire," may be reached by men of ideas, but not by men of the marts. Is it conceivable that the police of New York should assemble to fight a mob gathered to break up the opera of a certain composer? Is it conceivable that you students should crowd into this theater to prevent a speaker being heard, as those of the Sorbonne did some years ago in the case of Brunetière? If you should, no one in this city would understand you, and the police would be called on promptly to interfere.

A fair measure of the culture of your environment is the depth to which your morning paper prostitutes itself for the dollar, its shades of yellowness, its frivolity or its unscrupulousness, or both. I sometimes think it would be better not to read the newspapers at all, even when they are conscientious, because of their lack of a sense of proportion, in the news columns at least, of the really important things in American life. Our most serious evening

mentor of student manners and morals gives six columns to a football game and six lines to a great intercollegiate debate. Such is the difference between precept and practise. American laurels are for the giant captain of industry; when his life is threatened or taken away acres of beautiful forest are cut down to procure the paper pulp necessary to set forth his achievements, while our greatest astronomer and mathematician passes away and perhaps the pulp of a single tree will suffice for the brief, inconspicuous paragraphs which record his illness and death.

Your British cousin is in a far more favorable atmosphere, beginning with his morning paper and ending with the conversation of his seniors over the evening cigar. As a Cambridge man, having spent two years in London and the universities, I would not describe the life so much as serious as *worth while*. There are humor, and the pleasures of life in abundance, but what is done is done thoroughly well. Contrast the comments of the British and American press on such a light subject as international polo; the former alone are well worth reading, written by experts and adding something to our knowledge of the game. In the more novel subject of aviation we look in vain in our press for any solid information about construction. Or take the practical subject of politics; the British student finds every great speech delivered in every part of the empire published in full in his morning paper; as an elector he gets his evidence at first hand instead of through the medium of the editor.

Thus the young American is not lifted up by the example of his seniors, he has to lift it up. If he is a student and has serious ambitions he represents the young salt of his nation, and the college fraternity in general is a light shining in the darkness. Thus stumbling, groping, often misled by his natural leaders, he does somehow or other, through sheer force, acquire an education, and is just as surely coming to the front in the leadership of the American nation as the Oxford or Cambridge man is leading the British nation.

Our student body is as fine as can be, it represents the best blood and the best impulses of the country; but there may be something wrong, some loss, some delay, some misdirection of educational energy. Bad as the British university system may be, and it has been vastly improved by the influence of Huxley, it is more effective than ours because more centrifugal. English lads are taught to compose, even to speak in Latin and Greek. The Greek play is an anomaly here, it is an annual affair at Cambridge. There are not one but many active and successful debating clubs in Cambridge.

I believe the greatest fault of the American student lies in the over-development of one of his greatest virtues, namely, his collectivism. His strong *esprit de corps* patterns and moulds him too far. The rewards are for the "lock-step" type of man who conforms to the prevailing ideals of his college. He must parade, he must cheer, to order. Individualism is at a discount; it debars a man from the social rewards of college life. In my last address to Columbia students on the life of Darwin,[2] I asked what would be thought of that peculiar, ungainly, beetle collector if he were to enter one of our colleges to-day? He would be lampooned and laughed out of the exercise of his preferences and predispositions. The mother of a very talented

[2] "Life and Works of Darwin," *Popular Science Monthly*, April, 1909, pp. 315–340. (Address delivered at Columbia University on the one hundredth anniversary of Darwin's birth, as the first of a series of nine lectures on "Charles Darwin and His Influence on Science.")

young honor man recently confessed to me that she never spoke of her son's rank because she found it was considered "queer." This is not what young America generates, but what it borrows or reflects from the environment of its elders.

The faults with our educational design are to be discovered through study of the lives of great men and through one's own hard and stony experience. The best textbooks for the nurture of the mind are these very lives, and they are not found in the lists of the pedagogues. Consult your Froebel, if you will, but follow the actual steps to Parnassus of the men whose political, literary, scientific, or professional career you expect to follow. If you would be a missionary, take the lives of Patterson and Livingstone; if an engineer "The Lives of Engineers"; if a physician, study Pasteur, which I consider by far the noblest scientific life of the twentieth century; if you would be a man of science, study the recently published lives and letters of Darwin, Spencer, Kelvin and of our prototype Huxley.

Here you may discover the secret of greatness, which is, first, to be born great, unfortunately a difficult and often impossible task; second, to possess the *instinct of self-education*. You will find that every one of these masters while more or less influenced by their tutors and governors were led far more by a sort of internal, instinctive feeling that they must do certain things and learn certain things. They may fight the battle royal with parents, teachers and professors, they may be as rebellious as ducklings amidst broods of chickens and give as much concern to the mother fowls, but without exception from a very early age they do their own thinking and revolt against having it done for them, and they seek their own mode of learning. The boy Kelvin is taken to Germany by his father to study the mathematics of Kelland; he slips down into the cellar to the French of Fourier, and at the age of fifteen publishes his first paper to demonstrate that Fourier is right and Kelland is wrong. Pasteur's first research in crystallography is so brilliant that his professor urges him to devote himself to this branch of science, but Pasteur insists upon continuing for five years longer his general studies in chemistry and physics.

This is the true empirical, or laboratory method of getting at the trouble, if trouble there be in the American *modus operandi*, but a generation of our great educators have gone into the question as if no experiments had ever been made. In the last thirty years one has seen rise up a series of "healers," trying to locate the supposed weakness in the American student: one finds it in the classic tongues and substitutes the modern; one in the required system and substitutes the elective; one in the lack of contact between teacher and student and brings in preceptors, under whom the patient shows a slight improvement. Now the kind of diagnosis which comes from examining such a life as that of Huxley shows that the real trouble lies in the prolongation to mature years of what may be styled the "centripetal system," namely, that afferent, mediæval and oriental kind of instruction in which the student is rarely if ever forced to do his own thinking.

You will perceive by this that I am altogether on your side, an insurgent in education, altogether against most of my profession, altogether in sympathy with the over-fed student, and altogether against the prevailing system of overfeeding, which stuffs, crams, pours in, spoon-feeds, and as a sort of death-bed repentance institutes creative work after graduation.

There is no revolution in the contrary or efferent design. Like all else in the world of thought, it is in the germ at least as old as the Greeks and its illustrious pioneer was Socrates (469–399 B.C), who led the approach to truth not by laying down the law himself, but by means of answers required of his students. The efferent principle, moreover, is in the program of Perry and many other reformers to-day.

How do you yourself stand on this question? Is your idea of a good student that of a good "receptacle"? Do you regard your instructors as useful grain hoppers whose duty it is to gather kernels of wisdom from all sources and direct them into your receptive minds? Are you content to be a sort of psychic *Sacculina*, a vegetative animal, your mind a vast sack with two apertures, one for the incurrent, the other for the outcurrent of predigested ideas? If so, all your mental organs of combat and locomotion will atrophy. Do you put your faith in reading or in book knowledge? If so, you should know that not a five-foot shelf of books, not even the ardent reading of a fifty-foot shelf aided by prodigious memory will give you that enviable thing called culture, because the yard stick of this precious quality is not what you take in but what you give out, and this from the subtle chemistry of your brain must have passed through a mental metabolism of your own so that you have lent something to it. To be a man of culture you need not be a man of creative power, because such men are few, they are born not made; but you must be a man of some degree of centrifugal force, of individuality, of critical opinion, who must make over what is read into conversation and into life. Yes, one little idea of your own well expressed has a greater cultural value than one hundred ideas you absorb; one page that you produce, finely written, new to science or to letters and really worth reading, outweighs for your own purposes the five-foot shelf. On graduation, *presto*, all changes, then of necessity must your life be independent and centrifugal; and just in so far as it has these powers will it be successful; just in so far as it is merely imitative will it be a failure.

Against the centripetal theory of acquiring culture Huxley revolted with all his might. His daily practise in the centrifugal school was in the genesis of opinion; and he incessantly practised the precept that forming one's own opinion is infinitely better than borrowing one. Our sophisticated age discourages originality of view because of the plenitude of a ready-made supply of editorials, of reviews, of reviews of reviews, of critiques, comments, translations and cribs. Study political speeches, not editorials about them; read original debates, speeches and reports. If you purpose to be a naturalist get as soon as you can at the objects themselves; if you would be an artist, go to your models; if a writer, on the same principle take your authors at first hand, and, after you have wrestled with the texts, and reached the full length of your own fathom line, then take the fathom line of the critic and reviewer. Do not trust to mental peptones. Carry the independent, inquisitive, skeptical and even rebellious spirit of the graduate school well down into undergraduate life, and even into school life. If you are a student force yourself to think independently; if a teacher compel your youth to express their own minds. In listening to a lecture weigh the evidence as presented, cultivate a polite scepticism, not affected but genuine, keep a running fire of interrogation marks in your mind, and you will finally develop a mind of your own. Do not climb that mountain

of learning in the hope that when you reach the summit you will be able to think for yourself; think for yourself while you are climbing.

In studying the lives of your great men you will find certain of them were veritable storehouses of facts, but Darwin, the greatest of them all in the last century, depended largely upon his inveterate and voluminous powers of note-taking. Thus you may pray for the daily bread of real mental growth, for the future paradise is a state of mind and not a state of memory. The line of thought is the line of greatest resistance; the line of memory is the line of least resistance; in itself it is purely imitative, like the gold or silver electroplating process which lends a superficial coating of brilliancy or polish to what may be a shallow mind.

The case is deliberately overstated to give it emphasis.

True, the accumulated knowledge of what has been thought and said serves as the gravity law which will keep you from flying off at a tangent. But no warning signals are needed, there is not the least danger that constructive thinking will drive you away from learning, it will much more surely drive you to it, with a deeply intensified reverence for your intellectual forebears; in fact, the eldest offspring of centrifugal education is that keen and fresh appetite for knowledge which springs only from trying to add your own mite to it. How your Maxwell, Hertz, Röntgen, Curie, with their world-invigorating discoveries among the laws of radiant matter begin to soar in your estimation when you yourself wrest one single new fact from the reluctant world of atoms? How your modern poets, Maeterlinck and Rostand, take on the air of inspiration when you would add a line of prose verse to what they are delving for in this mysterious human faculty of ours. Regard Voltaire at the age of ten in "St. Louis Le Grand," the Eton of France, already producing bad verses, but with a passionate voracity for poetry and the drama. Regard the youthful Huxley returning from his voyage of the *Rattlesnake* and laying out for himself a ten years' course in search of pure information.

This route of your own to opinions, ideas, and the discovery of new facts or principles brings you back again to Huxley as the man who always had something of his own to say and labored to say it in such a way as to force people to listen to him. His wondrous style did not come easily to him; he himself told me it cost him years of effort, and I consider his advice about style far wiser than that of Herbert Spencer. Why forego pleasures, turn your back on the world, the flesh, and the devil, and devote your life to erudition, observation, and the pen if you remain unimpressive, if you can not get an audience, if no one cares to read what you write? This moral is one of the first that Huxley has impressed upon you, namely, *write to be read;* if necessary "stoop to conquer," employ all your arts and wiles to get an audience in science, in literature, in the arts, in politics. Get an audience you must, otherwise you will be a cipher instead of a force.

Pursuant of the constructive design the measure of the teacher's success is the degree in which ideas come not from him, but from his pupils. A brilliant address may produce a temporary emotion of admiration, a dry lecture may produce a permanent productive impulse in the hearers. One may compare some who are popularly known as gifted teachers to expert swimmers who sit on the bank and talk inspiringly on analyses of strokes; the centrifugal teacher takes the pupils into the

water with him, he may even pretend to drown and call for a rescue. In football parlance the coach must get into the scrimmage with the team. This was the lesson taught me by the great embryologist Francis Balfour, of Cambridge, who was singularly noted for doing joint papers with his men. An experiment I have tried with great success in order to cultivate centrifugal power and expression at the same time is to get out of the lecture chair and make my students in turn lecture to me. This is virtually the famous method of teaching law re-discovered by the educational genius of Langdell; the students do all the lecturing and discoursing, the professor lolls quietly in his chair and makes comments; the stimulus upon ambition and competition is fairly magical; there is in the class-room the real intellectual struggle for existence which one meets in the world of affairs. I would apply this very Socratic principle in every branch of instruction, early and late, and thus obey the "acceleration" law in education which I have spoken of above as bringing into earlier and earlier stages those powers which are to be actually of service in after life.

There is then no mystery about education if we plan it along the actual lines of self-development followed by these great leaders and shape its deep undercurrent principles after our own needs and experience. Look early at the desired goal and work toward it from the very beginning. The proof that the secret does not lie in subject, or language, but in preparation for the living productive principle is found in the fact that there have been *relatively* educated men in every stage of history. The wall painters in the Magdalenian caves were the producers and hence the educated men of their day. This goal of production was sought even earlier by the leaders of Eolithic men 200,000 years ago and is equally magnetic for the men of dirigible balloons and aeroplanes of our day. It is, to follow in mind-culture the principle of addition and accretion characteristic of all living things, namely, to develop the highest degree of productive power, centrifugal force, original, creative, individual efficiency. Through this the world advances; the Neolithic man with his invention of polished implements succeeds the Palæolithic, and the man of books and printing replaces the savage.

The standards of a liberal mind are and always have been the same, namely, the sense of truth and beauty, both of which are again in conformity with nature.

> Beauty is truth, truth beauty, that is all
> Ye know on earth, and all ye need to know.
> —KEATS' *Ode on a Grecian Urn.*

The sources of our facts are and always have been the same, namely, the learning of what men before you have observed and recorded, and the advance only through the observation of new truth, that is, old to nature but new to man. The handling of this knowledge has always been the same, namely, through human reason. The giving forth of this knowledge and thus the furthering of ideas and customs has and always will be the same, namely, through expression, vocal, written, or manual, that is, in symbols and in design.

It follows that the all-round liberally educated man, from Palæolithic times to the time when the earth shall become a cold cinder, will always be the same, namely, the man who follows his standards of truth and beauty, who employs his learning and observation, his reason, his expression, for purposes of production, that is, to add something of his own to the stock of the world's ideas.

One can not too often quote the rugged insistence of Carlyle: "Produce! Produce!

Were it but the pitifullest infinitesimal fraction of a product, produce it in God's name! 'Tis the utmost thou hast in thee: out with it, then."

Now note that whereas there are these six senses and powers of mind which subserve the seventh, namely, the power of constructive thinking, and whereas the giving out of ideas is the object to be attained, only one power figures prominently in our modern system of college and school education, namely, the learning of facts and the memory thereof. It is no exaggeration to say that this makes up 95 per cent. of modern education. Who are the meteors of school and college days? For the most part those with precocious or well-trained memories. Why do so many of these meteors flash out of existence at graduation? The answer is simple if you accept my conception of education. Whereas it takes six powers to make a liberally educated man or woman, and seven to make a productive man or woman, only one power has been cultivated assiduously in the "centripetal" education; whereas there are two great gateways of knowledge, learning and observation, only one has been continuously passed through; whereas there are two universal standards of truth and beauty, only truth has constantly been held up to you, and that in precept rather than in practise. For nothing is surer than this, that the sense of truth must come as a daily personal experience in the life of the student through testing values for himself, as it does in the life of the scientist, the artist, the physician, the engineer, the merchant. Note that whereas you are powerless unless you can by the metabolism of logic make the sum of acquired and observed knowledge you own, that kind of work-a-day efficient logic has never been forced upon you and you are daily, perhaps hourly, guilty of the *non sequitur*, the *post hoc non ergo propter hoc*, the undistributed middle, and all those innocent sins against truth which come through the illogical mind.

"That man," says Huxley, "has had a liberal education . . . whose intellect is a clear, cold, logic engine, with all its parts of equal strength, and in smooth working order; ready, like a steam engine, to be turned to any kind of work, and spin the gossamers as well as forge the anchors of the mind."

Note that whereas you are a useless member of society unless you can give forth something of what you know and feel in writing, speaking, or design, your expressive powers may have been atrophied through insufficient use. In brief, you may have shunned individual opinion, observation, logic, expression, because they are each and every one on the lines of greatest resistance. And your teachers not only allowed you, but actually encouraged and rewarded you, for following the lines of least resistance in the accurate reproduction, in examination papers and marking systems, of their ideas and those you found in books.

May you, therefore, write down these seven words and read them over every morning: Truth, beauty, learning, observation, logic, expression, production. In the wondrous old quilt work of inherited or ancestral predispositions which make your being you may be gifted with all these seven powers in equal and well-balanced degree; if you are so blessed you have a great career before you. If, as is more likely, you have in full measure only a part of each, or some in large measure, some in small, keep on the daily examination of your chart as giving you the canons of a liberal education and of a productive mind.

Remember that as regards the somewhat

overworked word "service" every addition in every conceivable department of human activity which is constructive of society is service; that the spirit of science is to transfer something of value from the unknown into the realm of the known, and is, therefore, identical with the spirit of literature; that the moral test of every advance is whether or not it is constructive, for whatever is constructive is moral.

I would not for a moment take advantage of the present opportunity to discourage the study of human nature and of the humanities, but for what is called the best opening for a constructive career give me nature. The ground for my preference is that human nature is an exhaustible fountain of research; Homer understood it well; Solomon fathomed it; Shakespeare divined it, both normal and abnormal; the modernists have been squeezing out the last drops of abnormality. Nature, studied since Aristotle's time, is still full to the brim; no perceptible falling of its tides is evident from any point at which it is attacked, from nebulæ to protoplasm; it is always wholesome, refreshing and invigorating. Of the two most creative literary artists of our time, Maeterlinck, jaded with human abnormality, comes back to the bee and the flowers and the "blue bird," with a delicious renewal of youth, while Rostand turns to the barnyard.

Henry Fairfield Osborn

AMERICAN EDUCATIONAL DEFECTS

Optimism, the national trait, was formerly the keynote of American public opinion. There used to be a serene confidence in the perfection of all natural, political or social conditions that seemed peculiarly American, and an equally serene indifference, or even contempt, for everything that differed from them. Recently, however, all this has changed; and we now find American public opinion directing towards native institutions and conditions a criticism so uniformly severe, and a denunciation so intensely bitter as to exceed the completeness of its approval and the fulsomeness of its praise in the past. Higher education is one of the latest things to be attacked, and as in the case of politics and business, every shortcoming that is inevitable, and every weakness that is universal in a human institution has been attributed solely to its influence. Under these circumstances, it is perhaps permissible to undertake an inquiry to determine just what educational faults and deficiencies may be regarded as peculiarly American; and there may be a certain advantage in having this inquiry made by a person who has come in contact with the educational system of this country, and yet has not been identified with it long enough to have come to regard its methods as natural, or prominently enough to feel in any way responsible for it; for most of its critics have been conspicuously lacking in personal knowledge of its organization, while most of its defenders have been prejudiced by regarding themselves as responsible for the creation, or at least the toleration of that organization and its results.

The first step in such an inquiry will be to establish what elements in an educational system are most important in producing its results, in other words, on what its efficiency and vitality mostly depend. It would seem at first sight as if this question would have to be answered after the manner of most pedagogical writers, that is, by saying that an educational system's success depends, in the first place, on the sort of knowledge it undertakes to impart, and in the second place, on the methods it employs to secure the assimilation of such knowledge. A little thought, however, will show

that the law of evolution is exemplified in the intellectual quite as much as in the physical world, and as physical organs are modified according to the use made of them, so are intellectual powers and limitations dependent, to a large extent, on the purposes that have stimulated and guided the minds exhibiting them. The sort of knowledge imparted and the methods of conveying it are thus of secondary importance in determining the effectiveness of an educational system, the far more significant thing being the purposes that underlie their selection and employment. These purposes, in turn, are the result in a given people of the theory of life imposed on it by its environment and experiences; so that if the physical characteristics and the history of the United States be examined, the ideas of life's opportunities and obligations they would be likely to foster can be determined, and as a consequence the real inspiration and guide of the American educational system discovered.

The territory occupied by the United States has been inhabited by civilized people only during modern times—a period within which the dominant activity of mankind has been commerce. Commerce is a secondary activity in a savage, barbarous or imperfectly civilized society, where hunting, pastoral or agricultural pursuits direct the mental as they do the physical activities of men. Commerce, however, is at once the foundation and the directing energy of our complex modern civilization, and has made all simpler economic activities subject to its laws and parts of itself. Its influence on life is thus very great in modern times, but there are special reasons why it is greater in America than anywhere else. It was a commercial impulse that led to the discovery of America, and economic pressure has impelled all but a small number of its settlers to its shores; while the virgin state of the country has made its material development the engrossing effort or interest of all its inhabitants up to a very recent time, and its great natural resources and advantages have created vast wealth with such rapidity as to make the economic activity imposed by necessity alluring as well. The philosophy we may expect these circumstances to develop, then, is that economic aims are the most laudable, economic pursuits the most attractive, and economic achievements the most valuable in life. We may also expect them to create a disposition to regard the principles of commerce as having universal application, and a tendency to confuse these artificial laws of limited application with the eternal verities.

Evidence of the effect of this philosophy is not hard to find in the conduct of American institutions of learning. Their commercialism is everywhere recognized, in fact, it is sometimes even recognized where it doesn't exist by overzealous advocates of reform. The fact is, that the American colleges feel that the greatest success is that which is commercially tangible, and so aim frankly at it, believing that they are most progressive when their methods are most analogous to those of purely commercial organizations. Publicity is courted in the smaller colleges in a way that suggests the philosophy, and often the phraseology of the late Mr. Barnum, who, probably without any knowledge of the Latin maxim, *Mundus vult decipi*, coined one of his own to the effect that the American people like to be humbugged. In the larger eastern institutions there is more sophistication, advertising being sought by more subtle and less direct means; but commercial aims are none the less the impulse behind them. It is even said that it is the practise of some institutions to employ scholarship funds in a way that will prove to their

own advantage rather than fulfil the spirit of the trust, as, for instance, by distributing benefices in as many different districts as circumstances permit, so as to advertise the institution as widely as possible instead of finding the most deserving recipients. Where this is done, there is probably no consciousness of its being wrong, so completely has the sense of the importance of commercial success blunted the conscience to other obligations.

It is commercial expediency also that causes American colleges to tolerate athletic excesses and other student indiscretions lest by suppressing them they should make themselves unattractive to undergraduates, and so reduce their revenue, and what is even more important, their prestige due to a large enrollment. The same motive justifies the adoption of an attitude that will be pleasing, or at least not offensive, to large donors or possible donors; something which often involves concessions to wealthy students which do not tend to keep either the moral or intellectual standards on a plane that commands respect. Commercial aims also justify the practise so common in America of teaching everything the latest popular or pedagogical whim demands, entirely irrespective of whether there is equipment to justify such attempts or not, or whether the subjects have any educational value or not. The practise of paying inadequate salaries to a large number of nominally qualified men instead of securing a less imposing array of competent teachers has a commercial basis, and so has the disposition to extend faculties by giving appointments to wealthy men who are willing to take their pay in the reputation for intellectuality such appointments are supposed to confer. Of course not all teachers who volunteer their services are sources of weakness; some of the most capable and effective men teaching in American colleges to-day are unpaid, but the majority of such men have all the superficiality and ineffectiveness of the amateur. Wealthy men, too, are often given places on the governing boards of colleges, in the hope that they will either contribute funds for their support during their lives or bequeath them money when they die. It is probable that many of them do one or both of these things, and it is unquestionable that many of them also render faithful and valuable services; but the practise, nevertheless, is the root of many evils. Men chosen for reasons such as these are, in general, prominent either commercially or as intellectual amateurs; and in neither case are they likely to have a profound, or even an intelligent, understanding of what qualities are necessary for success in educational work. The practical man of affairs mistakes aggressiveness for strength, with the result that many men are given preferment in teaching who are well adapted to commercial pursuits, but who lack the intellectual breadth and refinement necessary for success in any educational work that is more than elementary. The intellectual amateur, on the other hand, mistakes mental dexterity for creative power, and so brings a large number of teachers into prominence who are more or less brilliant according to drawing room standards, but whose moral and mental insipidity makes them as incapable of realizing as they are of discharging the grave responsibilities of their positions. Men of both classes are also occasionally guilty of more or less flagrant nepotism, and undoubtedly much of the popular opposition colleges are at present encountering is due to this, and to other evidences of the fact that, for reasons that are only commercially justifiable, they have subjected themselves to the control of men who guide them in accordance

with shallow views and class preconceptions.

The above are some of the familiar evidences of the effect of commercial ideas of obligation and necessity on the administration of American colleges; when it comes to the direct application of educational methods, there is evidence equally strong of the influence of the same ideas. Education, in the first place, is regarded as an economic tool, and there is no ability shown to administer it as anything else. There is an energy and sincerity behind instruction in professional subjects that forms a strong contrast with the listless and futile manner in which subjects having no readily discernible economic importance are dealt with. The result of this is a far higher efficiency in professional and technical schools than in colleges devoting themselves to the humanities; but it is an efficiency that is only relatively high, however; for the disposition to consider economic results alone leads to the elimination or neglect in such schools of all knowledge that has not a direct, or at least a fairly obvious indirect vocational application. The effect of this narrowness is to suppress all initiative except in economic activity, and as a consequence, American education has been unable to inspire any interest in pure science, in which the nation's achievements have been insignificant, while its activity and success in the commercial application of scientific principles is, perhaps, unequalled among modern peoples.

When we come to education which can not be regarded as an economic tool, and which must be justified on other grounds, we find the influence of a commercial philosophy less direct, its main effect being to make American ideas on such points shallow and almost childish, by engrossing the national intellect so completely with commercial conceptions as to make it helpless with anything else. The main way in which such education is justified is as the acquisition of information; and this view is very prevalent, for it has much to recommend it: it simplifies instruction by making it the mere distribution of information; and it makes it easy to determine scholarship by estimating it according to the amount of information possessed. Though not the fundamental reason for it, this view is instrumental in bringing about the excessive specialization that characterizes American even more than European education. Of course if education is the acquisition of information, no man can ever be completely educated, for the total of information is too great for the capacity of any one man; so the only thing to do is to limit one's aims to the acquisition of a manageable portion of it, and to confine all effort and interest to that portion alone. This leads to a lack of breadth, and to intellectual intolerance; lack of understanding of other subjects inducing contempt for them, while exclusive devotion to a single branch of learning gives an exaggerated idea of its importance. This intolerance exhibits itself by bringing about competition instead of cooperation between men who give instruction in different subjects. It is said by the graduates of one of the largest scientific schools in the country, that the majority of its students will cheat, without any consciousness of doing wrong, in any subject that is not a professional one. It is probable that this statement is somewhat exaggerated; but it is undoubtedly a fact that the unconscious attitude of many men high in academic circles is one of amused contempt for all branches of knowledge other than their own, and in spite of the fact that they are very insistent on the necessity of a broad education, their own in-

ward conviction is evident to the student, and is far more effective in forming his opinion than any merely perfunctory utterances that no more express personal belief than the forms of common politeness express personal regard. Such a theory of education as this, of course, makes no attempt to develop either the imagination or the judgment, and no credit is accordingly given for the possession of these qualities; so that the test for scholarship becomes largely physical in character, success in it depending on ability to apply one's self without remission to the acquisition and the retention intact of large masses of minute information, a task too monotonous and mechanical for any highly organized mind to endure without injury. The evils in the train of this theory are thus numerous. It propagates intellectual bigotry; it rewards mediocre intellectual achievement, and discourages by its neglect the cultivation of the higher powers of the mind; while the excessive application it imposes creates an environment in which leisure and reflection—both essential to true scholarship—are impossible.

Opposed to this theory, which makes anything like higher education impossible in most American colleges, is another, to some extent the outgrowth of it, in which it is perhaps easier to trace direct commercial influence. It is a belief that, although education is the acquisition of information, not all information is of equal importance, but that it must be valued according to its rarity, and like many articles of commerce, according to its remoteness from any possibility of use. The men who hold this theory do much to confirm the pedants just mentioned in the control of cultural education; for the public having to judge only between the two types (others being of very rare occurrence), justly regards the pedants as the more worthy of its respect; for they at least have vigor and activity to recommend them, and knowledge, that though ill-assorted and often of ridiculous insignificance, is still extensive; while their opponents have only languor, effeminacy and conceit to justify their claims to leadership. Apparently the pedants are grateful to their foes for this support, even though it is unwillingly afforded, or perhaps they really feel a consciousness of the insufficiency of their own teaching; at any rate, they show themselves extremely tolerant of their rivals, and very ready to accord them a certain amount of recognition. Professor Irving Babbitt has pointed out, in his "Literature and the American College," the prevalence of either pedantry or dilettantism in the teaching of literature in the United States; and he has made clear the further fact that there is an unholy alliance between them, and that pedantry occasionally recognizes dilettantism in order to avoid the necessity of acknowledging the claims of scholarship that might prove more dangerous to its supremacy. The effect of this dilettante theory is thus, directly, to encourage intellectual frivolity and presumption; and indirectly, by confirming the rule of pedantry, to place a handicap on real scholarship.

Cultural education is thus ineffective in this country because it has no direct economic application, and all attempts to justify it on other grounds have been lacking in intelligence or sincerity. Such attempts are of course incapable of arousing any sincere or lasting enthusiasm; so it is not to be wondered at that men who can inspire enthusiasm are even rarer in America than elsewhere. It is almost impossible for American colleges to find men who can lecture to large bodies of students with any success; and this has led to a great deal of

insistence on the advantages of small classes, and on the necessity of bringing the student into close personal contact with his instructors. There can be no doubt of the advantage of the former arrangement in most subjects, and of the desirability of the latter relationship wherever possible; but there can also be no doubt that the prevalence of the demand for small classes in American colleges is largely due to a failure to understand that enthusiasm can be an educational stimulus, and a consequent disposition to rely on compulsion alone. If a teacher lacks the power to interest a large class, he will not gain it by having a small one to deal with; he will, however, usually get better results, for the new arrangement will enable him to police his class better. Of course there is no royal road to learning, and much resistance has to be overcome, and much drudgery done before any subject can be thoroughly mastered, especially in modern times when the quantity and complexity of knowledge has increased so enormously. On the other hand, however, unrelieved drudgery imparts no creative power to the mind, especially if that drudgery is enforced. A drillmaster can teach an army the manual of arms, and how to execute all sorts of evolutions, but only a great general can inspire courage and enthusiasm in it by instilling into it a sympathy with the purposes of the campaign. American education undertakes to dispense with the general and get along with the drillmaster, largely because the drillmaster is a far commoner type than the general.

The prevalence of mediocre teachers in America is due to a number of complexly related causes; the first of which is a lack of emotional power, the basis alike of personal magnetism and spiritual insight. This is an age of rationalism, and rationalism reinforced by commercialism, in America, becomes pure sensationalism—something which is without moral sympathies, and therefore blind. No one would desire to have religious dogmatism control education again, but that is no sufficient reason for enduring something that errs as perversely in the opposite direction. There are more things in heaven and earth than are dreamed of in the philosophy of sensationalism, or in that of reason uninspired by moral instinct either. We count Shakespeare our greatest seer, and no one would dare to say that he submitted his reason to the domination of dogma or superstition; he sought for truth and sought it fearlessly wherever his gaze could penetrate, and the verdict after three hundred years is that it penetrated further, and perceived more justly than that of any other mind. Voltaire, however, a rationalist of the extreme type, could see but little in Shakespeare, whose feeling and fancy were largely outside the range of his comprehension. American education stands before the world's knowledge much as Voltaire did before the wisdom of Shakespeare —a large part of it lies outside the range of its comprehension, and therefore goes uninterpreted, even unperceived by it.

Another cause for the lack of inspiring teachers is the fact that commercialism begets a tendency to construct a criticism of life entirely in accordance with surface conditions, and a consequent inability to perceive truth in its ultimate form. Heraclitus of Ephesus regarded the universe as like a river, into which it is impossible to step twice and find it the same. Heraclitus, however, knew that though the waters might linger calmly in one place only to rush swiftly or plunge madly in others, according to the nature of their channel, they are yet controlled by laws that are fixed and invariable; so that it is the same force that impels them on all oc-

casions—one unchanging and eternal law of motion, the uniform character of which is disguised by the infinite variety of its temporary manifestations, the result of its force being modified by being transmitted through ever changing local conditions. Now in the case of a physical river, it is a far more difficult and a far more valuable thing for the mind to perceive that its motion is a manifestation of a force that is universal wherever there is matter, than it is to learn an endless number of special facts bearing on the causes of individual variations. Furthermore, all the special facts the most conscientious and painstaking study of the river alone can ever accumulate, will be insufficient to give any but a very deceptive notion of what this basic force really is; for to obtain that we must study, not the river alone, but to some extent at least, all matter, including even the most distant stars.

The figure of the river may seem too simple a representation of the complex problem of education, or one that views it from a standpoint that is visionary rather than practical. It affords, however, a very accurate illustration of the most characteristic weakness of American education—a disposition to deal with facts and to neglect principles. As is to be expected from this, American scholarship, where it has made itself at all conspicuous, has done so by exhibitions of minute or mechanical accuracy, or by extensive command of details. The inclination towards sensational philosophy of course makes its conclusions tend towards materialism, but this is curiously modified by the analogies of commerce, the creation of human caprice as much as of human necessity; so that all sorts of will-o-the-wisps are mistaken for fixed luminaries. This makes it the servile imitator of the most futile type of German pedantry, whose wide range of knowledge it can not hope to approach, but whose ridiculous indifference to the commonest demonstrations of experience it often surpasses.

It is, of course, unfair to say that all these faults are exclusively American; they are nearly all, to some extent, universal characteristics of the academic mind, or qualities that distinguish our age. It is fair, however, to say that they are more pronounced in America than elsewhere; for modern qualities have had a more favorable field for their development in this country than in older lands. On the other hand, however, modern tendencies have already run their course in America, and the reaction against them is already setting in; while in Europe their influence is still on the increase and is rapidly reducing education to a basis as commercial as that of this country. The opportunity for educational improvement is therefore greater in America than elsewhere, but so also is the need. Within fifty years the capital of the world will be on the North American continent, where also the stage is now being set for the most tremendous and the most momentous social struggle that civilization has ever faced. No longer can this country pay heed to nothing but immediate economic advantage; energy may have been sufficient initiative and shrewdness sufficient guidance for it when it was new and its opportunities unlimited, but now duty must lead and wisdom direct it when its economic and social situation has become so complex. The problem of conserving the physical resources of the country is a vast one, but a far vaster one is the development of the national intelligence to an extent that will fit it to deal with the infinitely complicated social and economic problems that the last century has developed. The present administration of education produces a one sided and inharmoni-

ous development as a consequence of its shallow conceptions of the purposes and possibilities of intellectual training. A public opinion must be created which will be intelligent enough to detect and reprehend methods that are insufficient or unworthy, and men that are ineffective or unfit, as well as to accord adequate recognition to men of high purpose and real ability. When such an opinion exists there need be no fear of a lack of men both willing to strive for and capable of earning the high distinction its approval will confer.

Sidney Gunn

Massachusetts Institute of Technology

HOWARD TAYLOR RICKETTS[1]

Dr. Ricketts came to the university in 1902 to join the newly founded department of pathology and bacteriology. He had just returned from a year's visit to European laboratories. Previously he was fellow in cutaneous pathology in Rush Medical College for two years, taking up that work at the end of his service as interne in the Cook County Hospital. His medical course he took at the Northwestern University Medical School, where he graduated in 1897.

He was a modest and unassuming man, of great determination and of the highest character, loyal and generous, earnest and genuine in all his doings—a personality of unusual and winning charm. His associates of the hospital and fellowship days who knew him well, knew his ability and energy, his distinct fondness for the day's work, all looked to him for the more than ordinary achievement.

He deliberately turned away from the allurements of active medical practise and decided to devote himself to teaching and investigation in pathology. He had early become possessed of noble ideals and had a pure love for the search after truth in his chosen field, which abided with him and gave him a high conception of all his duties and relations and placed a special stamp on his work. His instinct for research at no time was permitted to lie dormant and unused, but growing stronger it carried him on farther and farther, and in due time the university freely and in special ways promoted the work in which he was to accomplish such large results. The torch was placed within the grasp of hands fit to carry it forward, and during the few short years given him he advanced it farther than we may realize at this moment, because he broke open paths for future progress.

His earlier researches are all marked by rare insight, directness and accuracy, by clear and forceful reasoning; it is in his brilliant work on Rocky Mountain fever, however, that Dr. Ricketts fully reveals himself as investigator of the first rank. He took up the study of this fever in the spring of 1906 as a sort of pastime during an enforced holiday on account of overwork. The disease is a remarkable one; it occurs in well-defined areas in the mountains, is sharply limited to the spring months, varies greatly in severity, the mortality in one place being about 5, in another between 80 and 90 per cent. For some time it had been regarded as caused in some way by the bite of a tick. Dr. Ricketts promptly found that the disease is communicable to lower animals and that a certain tick, which occurs naturally on a large number of animals in those regions, by its bite can transmit the disease from the sick to the healthy animal.

These observations opened a new field, and henceforth he devoted himself untiringly to the investigation of the many problems that arose one after another as the work went on, both in the laboratory here and in the field. As we follow the various stages in the progress of this intensely active work it becomes very clear that Dr. Ricketts not only was gifted with imaginative power so that he could see and trace the various lines along which the solution of a problem might be sought, but that he also possessed in a full measure the capacity for that hard, accurate, patient work

[1] An address delivered by Professor Ludwig Hektoen at a memorial service in the Leon Mandel Assembly Hall, May 15, 1910. Reprinted from *The University of Chicago Magazine.*

necessary for the more difficult task of finding the one, true solution. This combination of speculative ability and the power to do steady toil and even drudgery often under great difficulties made him a great investigator and brought him success.

Some of the experiments devised to lay bare the secrets of the different orders of living things concerned in spotted fever are masterful in their ingenuity and comprehensiveness, notably those bearing on the hereditary transmission of spotted fever virus in ticks, on the occurrence of infected ticks in nature, and on the part played by small wild animals like the squirrel as source for the virus.

Having solved many hard questions he came to the conclusion that in man spotted fever depends simply on the accidental bite by an adult tick carrying active virus. As only adult ticks find their way to man and as they occur only in the spring, the peculiar seasonal prevalence of the disease is nicely explained. It is almost unnecessary to point out that the work furnishes clear and direct indications as to what to do in order to prevent the disease. Finally, last year, he discovered the immediate cause of spotted fever, namely, a small bacillus, which he found in the blood of patients and in ticks and their eggs. Strains of this bacillus present in ticks from different places vary greatly in morbific power or virulence, and this fact may explain why spotted fever varies so greatly in severity.

Many of the observations and discoveries in connection with this work have a much wider significance, and will surely prove of value and service on the ever-shifting battleground with infectious diseases.

Rocky Mountain spotted fever in many ways resembles typhus fever. As he was completing his three years' study of the Rocky Mountain disease, having determined its mode of transmission, its cause, and a rational method for its prevention, Dr. Ricketts became more and more strongly impressed with the thought which he had had for some time that the special knowledge and training thus acquired would prove of great value in the study of typhus fever and thereby perhaps be put to the best use. This idea met with encouragement, and in July of last year it was definitely decided to take up the study of typhus fever in the City of Mexico, that being the nearest place, so far as known, where any such work could be done. I speak of this date because I wish to make it clear that Dr. Ricketts reached his decision before and entirely independently of the establishment by the Mexican government of certain prizes for successful investigation of the typhus fever of Mexico (*Tabardillo*).

Typhus fever (also known as ship fever, camp fever, jail fever, hospital fever) has been one of the great epidemic diseases of the world. Its devastations are recorded on the dark pages of history, the pages that tell of war, overcrowding, want and misery. Until the middle of the last century it prevailed in practically all large European cities; now it has largely disappeared, owing, it is believed, to better sanitary conditions; but it is still smoldering in many centers, and in some places, as in Mexico, typhus in one of its forms now claims hundreds of victims each year. When it assumes its most virulent forms typhus fever may become one of the most contagious of diseases, and there is no disease that has claimed so many victims among physicians and nurses. It is stated that in a period of twenty-five years, of 1,230 physicians attached to institutions in Ireland 550 succumbed to typhus. Of the six American scientists who have studied the typhus fever of Mexico since December last three have been stricken and two have died—Conneff, of the Ohio State University expedition, and our Ricketts. It is when the sick are aggregated in hospital wards that the danger of infection is especially great. Until very recently nothing was known as to the cause of typhus fever and the exact mode of its transmission.

Fully acquainted as a matter of course with all the characteristics of the disease, Dr. Ricketts and his volunteer assistant, Mr. Russell Wilder, began their work in December last. Before many weeks had passed results of great importance were secured; it was

found that typhus is different from the Rocky Mountain fever, although they have many points in common; that the Mexican typhus is communicable to the monkey; and that it may be transmitted by an insect (*Pediculus vestamenti*). Some of these results are confirmatory of very recent results obtained by others, but on April 23 they were able to announce the new discovery of a microorganism, a bacillus, in the blood of typhus patients and in the insect. There is good reason to believe that this bacillus is the actual cause of typhus fever.

While courageously and devotedly pushing this and other work on to completion Dr. Ricketts was stricken with typhus, and the unfinished investigations of such fundamental importance must be taken up by others. Thus a young and noble career of great achievement and of large service to humanity came to a sudden and heroic end, and a new name was placed on the martyr roll of science.

Those near to him know that he fully understood the dangers to which he would be exposed and the risks he would run. He decided he would take those risks, meet the dangers with all possible means of prevention, and do the work that would come to his hands. And so he made the great sacrifice and gave all that a man can give for his fellow-men.

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

THE hospital of the Rockefeller Institute for Medical Research was opened on October 17. There were no special ceremonies, but a number of guests were present to inspect the hospital. At the same time it was announced that Mr. Rockefeller had given securities valued at $3,820,000 for the endowment of the institute, and that its organization had been completed.

The following announcement has been made:

The board of trustees is initially constituted as follows: John D. Rockefeller, Jr., Frederick T. Gates, William H. Welch, Starr J. Murphy and Simon Flexner.

The function of the board of trustees is to hold and care for the property of the institute, including the investment of the endowment funds, and to hold the entire income at the disposal and under the full control of the board of scientific directors, which is constituted as follows:

Dr. William H. Welch, of Baltimore, president; Dr. T. Mitchell Prudden, of New York; Dr. L. Emmett Holt, of New York, secretary and treasurer; Dr. Christian A. Herter, of New York; Dr. Simon Flexner, of New York, director of laboratories; Dr. Herman M. Biggs, of New York, and Dr. Theobald Smith, of Boston.

The final establishment of the Rockefeller Institute for Medical Research, with its present generous endowment, is the culmination of a series of carefully considered gifts, each one based on a thorough demonstration of existing needs and on evidence of competent stewardship of funds previously intrusted.

The initial gift was made in 1901, when $200,000 was given, to be used in a limited number of years in the form of grants to support research in different localities. In 1902 a gift of $1,000,000 was received to cover the erection of a laboratory building and the cost of running expenses for a few years. When the plans for the future organization of the institute were being prepared the necessity for having a hospital under the control of the institute was clearly felt.

Mr. Rockefeller became so clearly convinced of this need that the erection of a hospital was determined upon. For this purpose $220,000 remaining from the previous gift of $1,000,000 and an additional gift of $620,000 were used. Meanwhile, in 1907, while the first plans for the hospital were being prepared, Mr. Rockefeller gave $2,600,000, the first fund to be used solely for the endowment of the institution. With their first legal meeting, which took place this afternoon at the institute, the board of trustees assumed possession of Mr. Rockefeller's latest gift of $3,820,000.

The hospital, which will profit largely by the new income, is not to be regarded as a separate institution; it is merely a part of the working equipment for medical research controlled by the one board of directors. Being now intrusted with by far the largest sum of money available for medical research, and with a wonderfully generous and perfect equipment at their command, the directors have a high sense of their responsibility to the public for the careful discharge of their great trust.

The hospital will accommodate only about seventy patients. They will be selected to enable the physicians of the institution to study particular diseases on the combating of which all their strength and ability will be concentrated. Only a small group of diseases will be included at a time, so as to permit thorough concentration. As a result of this arrangement the patient will get the best treatment and the benefit of the most up-to-date medical information.

Up to the present time the work of the Rockefeller Institute was confined to laboratory studies of physiological and chemical aspects of diseases and to surgical and other problems that could be studied on animals.

The need for the direct study of diseases under conditions that would permit the most minute and accurate observations with the aid of a most comprehensive equipment led to the foundation of the hospital. The physicians of the institute will devote all their time and energy to the cure of the sick entrusted to their care. They will not engage in outside practise. But instead of being compelled to treat almost every kind of disease, as in a general hospital, they will concentrate on a few ailments without being diverted by attending to others.

The hospital will have physiological, chemical and biological laboratories to supplement those of like nature in the institute. The laboratories of the hospital will be devoted to investigations bearing on the diseases under treatment, while the laboratories of the institute will continue their investigations as conducted at present. Any discovery of a new remedy in the laboratory of the institute will be immediately available to the hospital, and a constant cooperation of the two divisions will be assured.

The medical staff of the hospital will consist of the director, Dr. Rufus J. Cole, formerly of Johns Hopkins University; Dr. Christian A. Herter, Dr. C. C. Robinson and four internes, Drs. Draper, Swift, Marks and Peabody. The diseases to be admitted to the hospital at its opening to patients will be infantile paralysis, pneumonia and heart disease.

FOUNDATIONS FOR RESEARCH AT BERLIN

At the celebration of the centenary of the University of Berlin Emperor William made an address, in the course of which, according to the report in the London *Times*, he said:

The present occasion seemed to him to be peculiarly appropriate for a fresh movement towards the completion of Humboldt's aims. Humboldt's scheme required, in addition to the Academy of Sciences and the University, independent institutions for research as integral parts of the whole. The foundation of such institutions had not kept pace in Prussia with the development of universities, and this lacuna, especially with regard to the natural sciences, was felt more and more with the growth of knowledge. They needed establishments for pure research in close touch with the academy and the university, but unhampered by the giving of instruction. The early provision of such places of research seemed to him to be a sacred obligation of the present day, and it was his duty to appeal for general interest in this cause. Large sums were needed and could be obtained only by universal cooperation and by sacrifices. He would say to everybody, "Tua res agitur," and he was confident of success. The plan had been communicated only to a small circle, but already considerable sums, amounting to between nine and ten millions of Marks, had been forthcoming, together with enthusiastic expressions of approval from different parts of the country. It was his wish to found a society under his own patronage and bearing his own name for the foundation and maintenance of research institutions. It would be the care of his government to see that the new foundations did not lack state assistance as far as was necessary. Might that day mark a fresh stage in the development of the intellectual life of Germany.

SCIENTIFIC NOTES AND NEWS

The annual meeting of the American Society of Naturalists will be held from December 28 to 30 at Cornell University, Ithaca, New York. The general program will consist of a symposium on the subject of "Genotypes or pure lines of Johannsen." Professor Johannsen himself, of Copenhagen, will contribute a paper, and other invited papers will be given by investigators working in the fields of inheritance and evolution. Each presentation will be followed by an open discussion. The naturalists' dinner will be arranged for the evening of December 29, when the president, Professor D. T. MacDougal, will deliver his address. Dr. Charles R.

Stockard, Cornell Medical School, New York City, is the secretary.

THE ninth annual meeting of the central branch of the American Society of Zoologists will be held in joint session with Section F of the American Association for the Advancement of Science at Minneapolis, Minnesota, beginning December 27, 1910. Titles of papers in order to appear on the printed program must be in the hands of the secretary, H. V. Neal, Knox College, Galesburg, Illinois, not later than December 10. Nominations for membership must also be in the hands of the secretary by that date.

THE Central Association of Science and Mathematics Teachers will hold its annual meeting at Cleveland, Ohio, on November 25 and 26. Reports of committees will be made and papers given in biology, chemistry, earth science, mathematics and physics. Addresses will be given by Harvey W. Wiley, of Washington, D. C.; Dayton C. Miller, of Cleveland; David Eugene Smith, of New York; J. P. Gilbert, of Illinois; Mark Jefferson, of Ypsilanti, and others. The program contains the names of forty-one speakers. Full information regarding the program, place of meeting, hotels, railroad rates, etc., may be obtained by addressing the secretary, James F. Millis, 330 Webster Ave., Chicago, Ill.

AT the semi-annual meeting of the Philadelphia College of Pharmacy, the following scientific men were elected to honorary membership: Wilhelm Ostwald, formerly professor of chemistry at the University of Leipzig; Josef Moeller, professor of pharmacology and pharmacognosy at the University of Graz; H. Wefers Bettink, director of the pharmaceutical institute of the University of Utrecht; Charles E. Bessey, professor of botany, University of Nebraska.

AT the recent celebration at Smith College the degree of Sc.D. was conferred upon Miss Florence R. Sabin, associate professor of histology at Johns Hopkins University.

THE U. S. Fisheries steamer *Albatross* returned in May from her Philippine cruise in the interests of the fish and fisheries of the archipelago, and is now at Sausalito, Cal. The chief naturalist of the *Albatross*, Mr. F. M. Chamberlain, will spend the winter in Washington engaged in the study of the fishes collected in the Philippines. Mr. Waldo L. Schmitt has been transferred from the Bureau of Plant Industry to be assistant naturalist on the *Albatross.*

DR. FREDERICK BEDELL, professor of applied electricity at Cornell University, has returned from a year's residence in Europe.

MR. J. A. DOUGLAS, demonstrator in geology at Oxford University, has gone on an expedition to Peru. The expedition has been sent out by Mr. W. E. Balston to take advantage, for geological research, of the excavations now in progress in the construction of new railways.

MR. SAMUEL F. HILDEBRAND, of the class of 1910, of the Indiana State Normal School, has been appointed scientific assistant in the Bureau of Fisheries at Washington. Mr. Austin F. Shira, of the class of 1910, of the University of Ohio, has likewise been appointed scientific assistant at the U. S. Fish Cultural Station at Homer, Minnesota.

THE International Medical Society, consisting of representatives from Mexico, United States and foreign countries will meet in El Paso, Texas, October 27–29. Dr. von Ehrlich, of Berlin, and Drs. Charles Wardell Stiles and Claude H. Lavinder, of the U. S. Public Health and Marine Hospital Service, will deliver addresses.

DR. FREDERIC S. LEE will give this year the Jesup lectures of Columbia University at the American Museum of Natural History. His subject will be "The scientific features of modern medicine," and the dates will probably be February 7, 14, 21 and 28 and March 7, 14, 21 and 28.

DR. ERNST GRAWITZ, of the University of Berlin, lectured at the Johns Hopkins Hospital on October 11 on "Diseases of the Blood."

DR. CHARLES WARDELL STILES, U. S. Public Health and Marine Hospital Service, began a

course of lectures at Johns Hopkins University on October 12, on "Medical Zoology and Animal Parasites."

The opening lecture of the session of the McGill Medical Faculty was delivered on October 3, by Dr. William Hunter, London, who spoke on "Antisepsis in Medicine."

The Page May Memorial Lectures in Physiology will be delivered at University College, London, on October 24 and 25, November 7 and 8 and November 28 and 29. The first course, dealing with neurology, will be delivered by Professor C. S. Sherrington, of the University of Liverpool.

The lectures to be given before the London Institution include the following: "Secrets in a Pebble-beach," by Cecil Carus-Wilson; "Malaria," by Major Ronald Ross, F.R.S.; "Smoke and its Prevention," by Professor Vivian B. Lewis; "Autumn and Winter," by F. Martin-Duncan; "The Art of Aviation," by R. W. A. Brewer; "Life and Work of Lord Kelvin," by Professor S. P. Thompson, F.R.S., and the "Art of Paleolithic Man," by Dr. A. C. Haddon, F.R.S.

Dr. DeForest Willard, professor of orthopedic surgery at the University of Pennsylvania, died on October 14.

The classification and cataloguing of the Simon Newcomb Library, the acquirement of which by the College of the City of New York has already been announced, has been completed by Miss Edyth L. Miller. This collection of 4,000 volumes and 6,000 pamphlets, which was presented by Mr. John Claflin, includes many important items in astronomical and mathematical publications. Among others, there is a first edition of Euclid's "Elements," a Pacioli of 1494 and the 1515 edition of the Almagest of Ptolemy. The library will soon be officially presented to the college by Professor Compton, head of the department of physics.

We learn from the Princeton *Alumni News* that at the new vivarium, which is now in use by the department of biology, the salt water tanks have been filled with sea water. A tank steamer was sent out to sea and brought in a fresh supply of water, which was transferred to Princeton by tank car and carried in water carts to the vivarium. By means of the circulating and filtrating system of the vivarium, this water can be used over and over again without detriment to the fish in it. Professor E. G. Conklin, who is in charge of the vivarium, has returned from a year's leave of absence, most of which he spent at the Marine Laboratory at Naples, and the work of stocking the vivarium is now under way.

The states of the South African union will present to the king a representative collection of living specimens of the wild animals of the country, and arrangements are already in progress for bringing together the collection and transporting it to England. The latter part of the task will be under the superintendence of the Zoological Society of London, in whose menagerie it is hoped that the whole collection will be ready for exhibition next summer, under the title of the King's African Collection.

The Omega chapter of the Sigma Xi of the Ohio State University has arranged its lecture program for the year. Dr. A. A. Michelson, Professor L. H. Bailey and Colonel G. W. Goethals, are to appear before the society and invited public on the J. C. Campbell Foundation. The following is a summarized program of the year's work:

November 9. Chapter. Professor R. C. Purdy on "Fluxes and Fusion" and Dr. Dachnowski on "Diseases of Peat and Muck Soils."

December 2. Public. Dr. A. A. Michelson, director of the department of physics of the Chicago University, on "Metallic Colors in Birds and Insects."

February 10. Public. Professor L. H. Bailey, director of the department of agriculture, Cornell University, on "The Country Life Movement."

——. Colonel G. W. Goethals, chief engineer upon the Panama Canal. His lecture will have to do with some of the scientific problems of his work. Date and subject to be announced later.

March 17. Chapter. Mr. Julius Stone on "The Grand Canyon of the Colorado," giving some of the scientific results of his expedition.

April 14. Professor E. F. McCampbell on

"Studies on the Venoms of Snakes and other Poisonous Animals."

The executive committee of the chapter for the year consists of Professors W. L. Evans, president; C. H. Morris, vice-president, and Charles Sheard, secretary.

THE Field Museum of Natural History's thirty-third free lecture course is as follows:

October 15—"The Bird Life of the Bahamas, with Special Reference to the Nesting of the Flamingo," Professor Frank M. Chapman, assistant curator of mammalogy and ornithology, American Museum of Natural History.

October 22—"Japanese Mythology as Represented in their Archeology," Dr. William Elliot Griffis, Ithaca, N. Y.

October 29—"Through Africa with Roosevelt," Professor J. Alden Loring, Owego, N. Y., field naturalist to the Roosevelt African Expedition.

November 5—"Wild Game of Alaska," Professor Wilfred H. Osgood, assistant curator of mammalogy and ornithology, Field Museum.

November 12—"What Plants Mean to Man," Dr. Charles F. Millspaugh, curator of botany, Field Museum.

November 19—"Gold Mining in Alaska," Professor Wallace W. Atwood, United States Geological Survey.

November 26—"Material Basis for Perpetuity of the American People," Dr. W J McGee, Washington, D. C.

December 3—"The Indians of the Province of Esmeraldas, Ecuador," Dr. S. A. Barrett, curator of anthropology, Public Museum, Milwaukee, Wis.

December 10—"Waste of Life in American Industries," Dr. Joseph A. Holmes, director of the United States Bureau of Mines.

Nature states that by the bequest of the late Mr. F. Tendron, for many years chairman of the St. John Del Rey Mining Company, the trustees of the British Museum have recently acquired a few choice mineral specimens. Conspicuous among them is a magnificent, and probably unique, crystal of pyrrhotite, measuring as much as fourteen centimeters across. The suite also includes smaller specimens of pyrrhotite, two specimens of the rare mineral chalmersite, some well-crystallized gold, etc.

THE *Journal* of the American Medical Association states that Professor Osler's "Principles and Practise of Medicine" has been translated into Chinese by Dr. P. B. Cousland, president of the China Medical Missionary Association, Shanghai. This undertaking has engaged Dr. Cousland for several years. The book is the only first-class work on medicine that has so far been translated into Chinese. Other translations are in progress. Dr. Cochrane, of Peking, is translating Heath's "Anatomy"; Dr. McAll, of Han-kau, Stengel's "Pathology"; Dr. Cormack, of Peking, Hutchinson and Rainey's "Clinical Methods"; and Dr. Neal, of Tsi-nan, Fuch's "Ophthalmology." A new and compact "Systematic Anatomy" is also passing through the press. An atlas of beautiful anatomic plates has just been printed for the China Medical Missionary Association by the Oxford Press at a cost apart from the letter-press of $2,500, a part of which has been contributed by the China Emergency Appeal Committee. As dissection of the human body is not yet allowed in China such plates are of great importance.

THROUGH the generosity of Mr. John E. Thayer, class of 1885, the Museum of Comparative Zoology of Harvard University, has recently received the valuable collection of letters and drawings of Alexander Wilson and John J. Audubon which belonged to the late Joseph M. Wade. The Wilsoniana contain Wilson's sketch of the "Sorrel Horse Inn," a sketch of his School House and seventy of his original drawings of birds. These drawings are in various stages of completeness, from rough outlines to finished paintings, and are, as has been noted, superior both in delicacy and in perspective to the plates engraved by Alexander Lawson for the American Ornithology. There are sixteen autograph letters of Wilson, ranging in date from 1803 to 1810, two autograph poems and his book of receipts for the engraving and coloring of the plates of his American Ornithology. A few years ago Mr. Thayer gave the museum seven volumes containing the original ledgers, day books and account books, with the list of subscribers, kept by Audubon and his sons during the publication of their works on the birds

and mammals of North America. The Audubonianа of the Wade collection consist of five original drawings of John J. Audubon and seventy-three of his autograph letters, written chiefly to Dr. John Bachman. There are a few letters of Mrs. Audubon, one of her son, John W. Audubon and sixty letters of another son, Victor G. Audubon. Some of the letters of Audubon and of Wilson are without doubt unpublished.

THE annual report of the Board of Scientific Advice for India for 1908–09 is abstracted in the *Geographical Journal*. Mr. Gilbert T. Walker, director-general of observations, contributes three reports on researches in solar physics, meteorology and terrestrial magnetism. The geological chapter by Sir Thomas H. Holland, director of the Geological Survey, covers fifty pages. Under the head of mineralogy is noticed the discovery of several new varieties and species of minerals characterized by the presence of manganese in small or large quantities. Among economic inquiries importance attaches to Mr. Murray Stuart's discovery of kaolin in the Rajmahal hills, suitable for the manufacture of china and porcelain. In one locality the quality of the clay is good, strongly resembling the Cornish china clays, and the quantity, speaking from a manufacturer's point of view, is unlimited. In three of the coalfields in these hills Mr. Murray Stuart lighted on some deposits of excellent fire-clay. These are, however, difficult of access at present and not very large. Under the head of Geological Surveys there is a variety of work achieved by Dr. Pilgrim in Baluchistan and Mr. Middlemiss and Mr. Datta in Kashmir and the Central Provinces. The report on geography and geodesy contains a brief review of Dr. Stein's and surveyors Ram Singh and Lal Singh's surveys in Chinese Turkistan and Kansu. The invar wire measuring apparatus ordered from Paris has been received, and an alley 97 feet in length is now being constructed in the grounds of the Trigonometrical Survey Office, in which a base 24 meters long will be laid down. The base will be laid out by means of the new 4-meter invar standard bar, now being manufactured at Geneva. In each of the end walls a frictionless pulley will be fixed, over which the wire to be tested will be strained. During 1908–09 four detachments were employed on principal triangulation, and in consequence the additions made to the Geodetic Survey have again been large. In all a length of 270 miles of triangulation covering an area of 9,600 square miles has been added. The districts in which the detachments were at work were northern Baluchistan, Shan States (Burma) and Kashmir. In May, 1908, Lieut. Oakes commenced the northern Baluchistan series, starting from the Kalat longitudinal series, and, working along the meridian 66° 31′ E., carried the new series northwards to 31° N. Hence onward the series will take an easterly direction, following as closely as possible the Afghan-Baluchistan frontier, and eventually closing on the great Indus Series. Mr. Tresham and Lieutenant Cardew continued this work, the latter executing 50 miles of triangulation enclosing an area of 1,900 square miles. In Burma, Captain Browne continued the Great Salwen Series, carrying the new triangulation forward for a distance of 120 miles, a small outturn due to the monsoon rains, heavy mists and, later on in March, dust haze, which compelled a stoppage of the work. In Kashmir Mr. de Graaf Hunter has started a new series which emanates from the northwest Himalaya Series.

THE U. S. Department of Agriculture estimates that the farmers of the single state of Iowa use every year $1,400,000 worth of new fence posts, which cost the equivalent of $600,000 for setting them in the ground. Further, the department officials believe that a part of this expenditure might be saved. The opportunity for economy is found, first, in using the kinds of posts which, taking into account both cost and durability, are cheapest in the long run, and, secondly, by treating the posts to prevent decay, particularly those which decay most quickly. When a farmer sets a post which will have a comparatively short life, he loses not only through having to buy a new post but also because of the additional

labor involved in setting it. It is true that in both cases no money outlay may be involved, for he may set the posts himself, after getting them from his own wood-lot. Of the posts used last year in Iowa, seventy per cent., it is estimated, were grown on the farms where they were used, or were obtained from other farmers or wood-lot owners, and only thirty per cent. were bought from lumber dealers. Nevertheless, the farmer is out his labor and the part of the product of his wood-lot which is used up, even though he does not pay out any cash. The facts concerning the use of fence posts in Iowa were brought out by an investigation which the Department of Agriculture has been making through inquiries sent to farmers. Several thousand replies have been used in compiling the figures, which, combined with statistics issued by the Iowa State Board of Agriculture as to the number of farmers and the acreage, furnished the totals. According to these totals about 10,000,000 posts are called for yearly to build and repair fences on 209,163 farms, of an average size of 158½ acres each. The average life of a fence post is stated to be fourteen years and the average cost 13.7 cents. There is, however, great difference in the lasting properties of different woods. Osage orange lasts more than five times as long as willow does, and for length of service it heads the list of post timbers in the state. The comparative life of other posts is shown in the following list ranging from the longest period to the shortest: red cedar, locust, white oak, northern white cedar (or arborvitæ), catalpa, black walnut, butternut, red oak and willow. The average cost of posts varies for different woods, and for the same woods in different localities. Red cedar is most expensive, at an average of 26¾ cents each, and willow the cheapest, at 6 cents. Taking into consideration the time a post will last, and the cost of buying it and setting it in the ground, the conclusion must be drawn that the osage orange post is the most economical in Iowa, followed by white oak, locust, catalpa, red cedar, black walnut, butternut, willow, white cedar and red oak, in the order named.

UNIVERSITY AND EDUCATIONAL NEWS

By will of Ezra J. Warner, '61, Middlebury College will receive $25,000 as an endowment for the care and maintenance of Warner Science Hall and the purchase of apparatus and supplies for the departments which are housed in that building.

A scholarship valued at $1,000 per year for advanced work in architecture has been offered to the trustees of the University of Illinois by Mr. Francis John Plym, of Niles, Mich.

The trustees of Princeton University have accepted the resignation of President Woodrow Wilson and have elected John A. Stewart, senior trustee, to be acting president. Dr. Wilson retains the McCormick chair of jurisprudence and political history.

Dr. John B. Elliott, Jr., has been made chief of the department of medicine of Tulane University, to succeed Dr. George Dock; Dr. J. Birney Guthrie has been made professor of clinical medicine, and Dr. R. Clyde Lunch, professor of oto-rhino-laryngology in the post-graduate department.

Dr. Robert W. Hegener has been promoted from instructor to assistant professor of zoology in the University of Michigan.

Henry R. Kreider, Ph.D. (Hopkins), has been appointed assistant professor of Chemistry at the Baltimore Medical College.

The department of botany at Syracuse University is enlarged by the addition of Assistant Professor L. H. Pennington, recently of Northwestern University. Laboratory equipment is being installed for work along the lines of physiology and plant pathology.

At Princeton University there have been appointed to instructorships, Richard L. Cary in mathematics and Mr. K. K. Smith in physics.

Mr. W. L. Upson, of the Ohio State University, has been appointed professor of electrical engineering in the University of Vermont.

Professor Payr, of Griefswald, has been called to Königsberg as director of the surgical clinic to succeed Professor Lexer, who goes to Jena. Payr's successor is Professor

Fritz König, of Altona, a son of the noted Berlin surgeon.

DISCUSSION AND CORRESPONDENCE

NOMENCLATURE AT BRUSSELS

FROM the report of the chief features of the rules of nomenclature adopted at the Brussels Botanical Congress, which recently appeared in SCIENCE,[1] it appears to the writer that while some advance has been made, we are still far from a satisfactory solution of the problem.

One important feature of the rules adopted is the establishment of multiple dates or starting points for the nomenclature of different groups of plants. Eight different dates have been adopted and it is proposed to select still others later. It is difficult to see what good can be accomplished by the use of different dates as starting points for different groups. It has been urged that the adoption of an early date, as 1753, in the case of many groups of cryptogams, involves the recognition of numerous uncertain and obscure genera and species. This is a difficulty which can not be escaped. Whatever date may be selected there will still be many of these uncertainties and no manipulation or multiplication of dates will serve to avoid them. If the purpose is to avoid such inconveniences, why not adopt as recent a date as possible? It is doubtful, however, whether we shall ever be able to devise a plan which will relieve us of the necessity of deciding, in many cases, whether genera and species shall be discarded as unrecognizable or accepted on tradition or arbitrary authority. The adoption of multiple dates simply multiplies the difficulties of applying the rules.

The case of lichens and fungi furnish an excellent illustration of this. The rules, of course, do not recognize the growing belief on the part of many botanists that lichens are really fungi and should be treated as such taxonomically and nomenclatorially. It is well known to biologists that the boundaries of all groups of living organisms are more or less uncertain and indefinite and authorities frequently differ as to whether a genus should be placed in one group or another. Certain genera are treated by some authors, even those who believe in the autonomy of the lichens, as simple fungi and by others as true lichens. Such cases are multiplied as each new starting point is adopted, which necessitates the drawing of new arbitrary lines of separation between groups of genera and species. It necessarily follows, therefore, that to reach uniform results in the application of the rules, there must be an arbitrary assignment of all the genera involved to particular groups before the date to be followed can be determined.

Then again, the evolutionary and historical aspects of the subject would seem to deserve some slight recognition and consideration. Plant names, like everything else, have a history and evolution which in many cases is closely associated with the growth of our knowledge of the biology of the organisms to which they are applied, and though we may not be justified, in this utilitarian age, in the opinion of some at least, in burdening science with the names of the discoverers or describers of genera and species and though we may deny that any ethical questions are involved in crediting or discrediting such persons, it is doubtful whether we are justified in ascribing to Fries or Persoon, or any other mycologist, the genera and species of previous authors which they have either confused, misconstrued or appropriated entirely. Such a procedure seems to be approved and endorsed by the form of citation adopted by the congress as illustrated by the example given: "*Boletus edulis* Fr., instead of *B. edulis* Bull.," or the clumsy form, "*B. edulis* Fries ex Bull." Why not write *B. edulis* Bruss. Cong., or omit entirely all citation of author or authority, and thus at least avoid misleading those who know nothing of the history of the organism and its name.

These matters are, however, of very slight importance compared with the fundamental question of types, a question which does not

[1] Farlow, W. G., and Atkinson, Geo. F., "The Botanical Congress at Brussels," SCIENCE, N. S., 32, pp. 104–107, July 22, 1910.

seem to have been considered by the congress. Without some method of fixing once for all the types of genera and species, we can see no possible hope of securing any great degree of uniformity or stability in the use of plant names, especially those applied to the fungi. As the writer has pointed out in another place,[2] generic names even when applied to monotypes have been and are at present transferred from the original species to another species or group of species without hesitation. There would seem to be little justification or excuse for such a procedure in the case of monotypic genera, but in many other cases where genera are composed of heterogeneous groups of species, as so frequently happens, owing to our lack of exact knowledge of the morphology and biology of the organisms, the segregation of such groups of species by different authors, very naturally leads to quite different results in the application of the original generic name or names. A generic name may be applied by one author to the largest group of the species which he regards as congeneric, by another, on account of personal preference or some other method of procedure, to some other species or group of species, so that without some provision or method of fixing once for all the generic name to some single species as its type, it would seem impossible to attain any great degree of stability or uniformity in the application of plant names.

If the purpose of the rules is to attempt to avoid change and to conform to "present usage," whatever that may mean, the only provision likely to accomplish it is that which provides for the adoptation of a list of *nomena conservanda*. This provision nullifies all the rules and makes it possible to adopt any name which may be preferred by the congress. With such a list of names open for the addition of others it might at first be thought that it would be possible to satisfy all interested.

Without considering the possibility that personal preferences might influence the selection of the names to be included in such a list, there would still be great difficulty in deciding what names are entitled to adoption. Admitting, however, for the sake of argument, that these difficulties are imaginary and that we have a list of genera and species agreeable to all, there is still not likely to be much hope for uniformity in the use of the names, as different authors deriving their concepts of genera from different descriptions, interpretations or authorities, will still apply them differently. This may seem very improbable to those who are only familiar with the taxonomy of the flowering plants, which are so well known and understood, that it is not often that a heterogeneous group of species belonging to three or four or more different genera are found confused under one name, as is quite frequently the case among the fungi. This condition of affairs makes it practically impossible to secure uniformity in the use of *nomena conservanda* until some type method is adopted and each generic name firmly fixed to one species with which it must always be associated.

It would appear that the congress might have studied, with profit, the rules which have been formulated and published by the international zoologists who have advanced further in their solution of the problems of nomenclature than most of the botanists. The zoologists have recognized the fundamental importance of the type method and have adopted it.

The fact that the problems of nomenclature have assumed sufficient importance to be considered by international congresses should perhaps sustain our hope for further progress, especially when we recognize that such matters are subject to the general laws of evolution and education and that perfection can not be attained at a single bound, but must be approximated only and that by slow and tedious steps. There is no doubt, however, that we are slowly progressing in these matters and that we shall eventually evolve order out of the present chaos.

C. L. Shear

[2] Shear, C. L., "The Present Treatment of Monotypic Genera of Fungi," *Bull. Torr. Bot. Club*, 36: 147–151, 1909.

SCIENTIFIC BOOKS

Medusæ of the World. Volumes I. and II. The Hydromedusæ. By ALFRED GOLDSBOROUGH MAYER. Published by the Carnegie Institution of Washington. 1910.

No one could have approached this task with a better equipment than has Dr. Mayer. Serving for many years as the assistant and companion of such a master as Alexander Agassiz, naturally endowed with keen observational powers, possessed of very exceptional talent as an artist and enjoying the familiarity with his subject which comes from a careful study of a host of living forms in many parts of the world, Dr. Mayer is as well prepared as any man for a monographic treatment of the Medusæ of the world.

The two quarto volumes under review contain 498 pages of text, 30 pages of index, 55 colored plates and 327 text figures. One of the most striking and satisfactory features of the work is the very sensible plan adopted of putting the plates where they logically belong—in the text with the descriptions and discussions of the forms illustrated. This is a concession to convenience and common sense that is extremely refreshing; a practise ordinarily tabooed by publishers, but one that will be welcomed by the actual users of books. The plates themselves are just what was to be expected from Dr. Mayer's pencil and brush, thoroughly satisfactory representations of these exceedingly delicate and beautiful organisms. The lines are in blue and the natural tints of the colored parts are faithfully reproduced, the author's exceptionally extensive acquaintance with the living medusæ giving him a rare power to express both their colors and characteristic attitudes.

The text figures are abundant and well chosen. Many of them being tracings of the drawings of other writers, they are necessarily of less uniform excellence than the plates, although they will prove exceedingly useful to the practical worker in this group.

The text gives a thoroughly monographic treatment of the Hydromedusæ, and the author is fully justified in his claim that "this book aims to be something more than an old-fashioned systematic treatise, for it attempts to record, if not to review, all works upon the embryology, cytology, œcology, physiology, etc., of all forms coming within the scope of the text" (p. 3).

In his systematic treatment the author has found it necessary to frequently revise the work of his predecessors, notably that of Haeckel, the changes in the larger groups being mainly in the combinations of the families of that writer. For example, Mayer's Oceanidæ = Margelidæ + Tiaridæ of Haeckel's classification, and Solmonidæ of Mayer = Solmonidæ + Peganthidæ of Haeckel, thus lowering several of the latter writer's families to subfamily rank. The definitions are clear cut and tersely put, being thus a distinct improvement on the verbose characterizations of many monographic works.

The numerous tables and keys to genera and species will prove very helpful to workers both in the Hydroida and Hydromedusæ, including the hydroid names of all of the medusæ so far as the former are known. Of course it can not be expected that all of Dr. Mayer's determinations will be acceded to by other writers; but this matter can not be properly discussed in the present review. In general, however, it can be said that the author has shown a keen insight in his determination of the hydroid as well as the medusa forms. There is something extremely canny, moreover, in his treatment of the species of particularly troublesome genera, *e. g.*, *Obelia*, where he gives a tabular statement of the characteristic of "the so-called species of *Obelia*," thus avoiding committing himself unwisely on the one hand and drawing upon his devoted head the thunderbolts of outraged authors of species on the other.

Something over 500 species are described, as compared with 400 in Haeckel's great work. This difference, however, does not properly represent the number of new forms described since the appearance of that monograph, as Mayer's synonymy shows that he has often combined several previously described species in one, as in the case of *Sarsie tubulosa* Lesson, in which *S. mirabilis* Agassiz is included as a variety, besides five other species described by various authors.

The work does not attempt to straighten out the great confusion arising from different names having been bestowed on the hydroid and medusa phases of the same species, and vice versa, *i. e.*, the same names given different species and genera. While this is, of course, to be regretted, the author is fully justified in his statement (p. 3), "These and many other cases of a similar nature interpose a barrier to our attempt to invent a system which includes all hydroids and medusæ in its embrace." The hopelessness of such an attempt is realized when we see that two thirds of the genera of Leptomedusæ in which both hydroid and medusa forms are known have different names for the colonial and medusoid phases in the life history of the same species.

He has been careful, however, to give the hydroid name, whenever it is known, in discussing each species, as well as a description, and often figures, of each hydroid which is known to produce medusæ.

The carefully prepared synonymies under each genus and species is particularly valuable in pointing out the errors of previous writers, as well as giving all names by which the species or genus has been known; *e. g.*, under "*corynitis* McCrady" he says: "Non *Corynitis* Murbach, non *Corynitis* Nutting, non *Corynitis* Hargitt," thus correcting a serious error which had been made by successive writers. It is unfortunate, however, that these synonymies are printed in such small type as to be trying to the eyes when they are studied for any considerable length of time.

The work is replete with interesting facts concerning the embryological and experimental discoveries regarding the species discussed, including a very complete résumé of all that is known through the investigations of the numerous workers in this group.

The author regards the Trachymedusæ and Leptomedusæ as being transformed actinules, and the Anthomedusæ and Leptomedusæ as being formed on a different plan, with their bells not homologous with those of the first-named orders. A further discussion of this exceedingly important point would have been much appreciated by Dr. Mayer's fellow workers.

In one respect the work could have been improved. It seems to the reviewer that a preliminary discussion of the morphology of the group, or of the several orders, corresponding in general to that given by Allman in his "Gymnoblastic Hydroids" would have been very helpful, especially to those interested in the medusæ but not familiar with the technical terms employed and the homologies of the parts, particularly those homologies which exist between the various parts of the hydranth and medusæ and the various forms of gonosome.

There is also occasional inconsistency in sometimes including and sometimes omitting the name of the authority after the specific name: *e. g.*, "*Steenstrupia rubra* Forbes" and "*Steenstrupia aurata*" (pp. 31, 35).

The reviewer, however, so thoroughly admires this excellent piece of work that he finds himself in no mood for criticism of small details. "Medusæ of the World" is a monumental work which will take the very first rank and be a classic of which the Carnegie Institution may well be proud, and for which the author is to be heartily congratulated.

C. C. NUTTING

STATE UNIVERSITY OF IOWA

Identification of the Commercial Dyestuffs. By Professor SAMUEL PARSONS MULLIKEN, of the Massachusetts Institute of Technology. New York, John Wiley & Sons. 1910.

This elaborate treatise has just appeared as Vol. III., of the author's "Method for the Identification of Pure Organic Compounds," and represents an enormous amount of careful and laborious investigation on the part of Professor Mulliken and his assistants. They present here careful records of ten or more separate tests, some of them involving the skillful use of the spectroscope, upon nearly 1,500 different dyestuffs; and the results of these experiments have been expressed in the form of elaborate analytical tables, by which,

as in a system of qualitative analysis, this great mass of compounds has been split up and divided and subdivided into general divisions, subdivisions and sections. Presumably, by the systematic use of these tables, after a very considerable amount of practise on the tests themselves, it ought to be possible for a careful manipulator, without any previous knowledge of dyestuffs, and with absolutely no experience in the art of dyeing, to separate and positively identify any one of these hundreds of dyestuffs, much as a college freshman can separate and identify barium or bismuth in a qualitative mixture.

Whether these elaborate tables and this vast number of carefully classified experiments will accomplish this desired result, as the author evidently expects, seems to the present writer to be still rather an open question.

He has not had the leisure to spend some weeks of constant work, in making himself familiar with the methods described, and with the rather formidable looking hieroglyphics in which the results of the experiments are expressed—work which would certainly have to be done before he could test the analytical tables upon commercial dyestuffs.

While glancing over the book, however, he did notice one place, at any rate, where the system seemed at fault. On page 52, under Genus I., Division B, Section of Orange Yellow Colors on Wool, No. 81, can be found carefully described the well-known mordant dyestuff of the Meister Lucius and Brüning Co., Cœruleine S, powder. This division of Genus I., by the way, corresponds, so it is stated, to azines, oxazines, thiazines, etc. Just what the chemical classification of Cœruleine S really is, the writer does not know, nor, indeed, care. But he does know that the same Meister, Lucius and Brüning Co. sell exactly the same dyestuff, in a paste form, under the name of Cœruleine, S. W. Paste. And it was, accordingly, with some surprise that this latter coloring matter was found as No. 1,153, page 224, carefully located in Genus IV., Division B, Subdivision 1, Section of Green Colors on Wool, under the heading of "Pyronine, Thiobenzyl and Azo-derivatives." It seems curious that the addition of a little water should make such a difference!

It is, of course, impossible that in such an elaborate and complicated work as this no errors should arise. Very possibly this is the only case of that sort in the book; although it would be interesting to have a study made of it by representatives of the great color houses, who, each knowing their own dyestuffs, could readily pick out any similar slips, if they were present.

A more serious criticism, that may with good faith be directed against this remarkable monument of industry, is that the distinguished author, full of his scheme for a vast qualitative separation of pure organic compounds of every description, has attacked this most practical problem of the identification of dyestuffs, from a purely theoretical standpoint. To paraphrase Wordsworth, "A dyestuff by the river's brim, an *organic compound* is to him and nothing else." He has treated these coloring matters as though they were part of a collection of organic chemicals on the shelves of a chemical museum, whose labels had fallen off; and in no part of the book is there a suggestion of the importance of assisting the practical dyeing chemist in his work, or of calling in his assistance, in return.

Now this attitude, it seems to the writer, is distinctly unfortunate, and very seriously interferes with the value of the book for any purpose, excepting, possibly, as a storehouse from which, with a good deal of difficulty, some information can be dug out about special scientific tests for a vast number of dyestuffs. It is very doubtful whether, as matters now stand, any dyeing chemist would go so far out of his way as to try to solve a dyeing problem by means of these quite unpractical schemes and separations. And, most of all, the more carefully and conscientiously these analytical tables are studied and experimented with, the more hopelessly astray would the student find himself, when brought face to face with any practical dyeing problem.

For these dyestuffs are not simply organic

compounds belonging to the azine or pyronine or oxyketone or other classes, according to their composition and the arrangement of their atoms or their molecules. They are important and indeed fundamental tools in a great industry, and are of interest and of value, not on account of their composition, but for their power of coloring various substances useful and valuable shades of color. And everybody who has anything to do with dyestuffs, outside of a research organic laboratory, studies them with this practical end in view. Their number and variety are so great that in order to get any idea of them at all they must be classified. But these classes, excepting, as before, in some research organic laboratories, are invariably based upon their dyeing properties. Not one dyeing chemist in a hundred could distinguish a thiazine from a thiobenzenyl derivative; but every one of them, from the gray-haired chief of a great color laboratory, to the bright-eyed laboratory boy picking up points about dyes in the intervals of scrubbing the floors or washing out beakers, would know the difference between, for instance, a vat dye and a basic dye—would know how they were applied, upon what fibers, with what general results—in other words, would know how they were used and what they were used for. These classes are not numerous, perhaps seven in all—the direct cotton or salt colors, basic, acid, mordant, vat, sulphur and developed colors. But into these seven classes, all commercial dyestuffs, not only *may* be divided, but *must* be divided, in order to have any idea of how they can be utilized.

The next most important and most distinctive characteristic of a dyestuff is that it dyes some particular color—on wool, cotton or other textile fiber. This furnishes a second, very simple and extremely practical method of subdivision. First, we determine *how* a coloring matter dyes, and, secondly, *what color* it dyes. These two tests can be made in a very few minutes, furnish most valuable practical information, and, in a great majority of cases, furnish all the information that it is necessary to know about a color.

If a dyer is asked to give an estimate on a thousand pounds of cotton yarn to dye to match a given sample, he certainly does not care about the chemical composition of that color, nor, excepting under special circumstances, about the absolute identity of that particular dyestuff. If the chemist tells him what class the color belongs to, whether a salt color, cheap and not fast to washing, or a vat color, very expensive, and exceedingly fast to both washing and light, or a sulphur color, fast to washing and not to light, or a basic color, very brilliant, quite fugitive in sunlight, needing careful mordanting before dyeing, or even a mordant or alizarine color, with all the trouble and expense that that means—then the dyer can estimate at once the expense of matching that color, and the problem is solved.

Accordingly, in every dyeing laboratory, and in almost any, if not every, dyeing school, the students are first taught this practical classification, and then the different important dyes in each class, and what their peculiarities are. After some experience the chief colors in each class come to have an individuality, so that they can be recognized at once, as soon as they are dyed. As one dyeing chemist told me, "It's like recognizing a boy you have known among a crowd of others. You can't tell offhand just what strikes you about him, but '*That's Johnnie.*'" And every hour's work on the dyes, working with the practical side in view, teaches more and more about their properties, and enables the problems that come in to be solved more readily and rapidly.

And this is necessary, for in a dyeing laboratory the problems are apt to come in fast and thick. The morning's mail may bring in samples of colors, batches of yarns, scraps of linen, cotton, silk, artificial silk and mixed goods, paper, calico, pigment and the like, in bewildering numbers, all to be matched, and in some cases identified, and all to be finished and cleared up before closing hours, or at latest before next morning's mail is distributed. There is no time here for elaborate

tests, based on chemical composition, for genera and divisions and subdivisions and sections, for careful study with the spectroscope in a dark room, to determine whether a dyestuff is a triphenyl methane or a nitro derivative. The sample is taken up, the class determined and noted. It is found, for instance, to be a salt color, on cotton, unmixed, a rather dark shade of red. Out come the well-thumbed sample books, Cassella, Metz, Badische, Elberfeld, perhaps one or two others, who have a good line of those colors. The page of red salt colors on cotton is reached, the sample is compared. In a minute or two more it is checked off—probably Diamine Fast Red B, Cassella—or Dianil Red BB, Metz; then these are looked up in Schultz & Julius, last edition, one or two simple tests are made—probably a dab or two of acid on each—and the color is identified.

In many cases the experience of the laboratory will fix on the color, and the sample books, like the chemical tests, will only be needed as confirmation. The sample, for instance, is red worsted yarn, used in stockings. The tests show an unmixed acid color, not after chromed. It must, to be satisfactory, be fast to washing and to perspiration. Only one or two colors *of this class* answer these requirements. The chemist knows, then, at once, that it must be this, or that, or the other. A few simple tests, and the particular one is determined.

A specially unfortunate result of the purely theoretical character of the tests in this book is the extraordinary way in which colors of entirely different classes and shades, come out together in the final separations. The sections, into which the compounds are finally classified, after being broken up into genera, divisions and subdivisions, are based on the shades given on wool. Every dyeing chemist, when he first sees that, will recognize it as a natural and useful method of final classification. Imagine his astonishment, then, when he inspects the colors forming one of these sections, as, for instance, one taken at random on page 64, headed "Section of Yellow Orange Colors on Wool," and finds among the eight colors there set down, Indian yellow J (an acid yellow used on wool and silk), six salt colors, dyeing cotton various shades of orange, and a *leather black!* In almost every section can be found acid and basic, salt and vat colors mixed together in almost inextricable confusion, and, thanks to the strange way in which the dyeing tests on wool are made, instead of the red colors being by themselves, and the blues and violets and oranges all separated, as they would have to be for any useful purpose, every color of the spectrum may be brought together in the same class.

A Color Standard.—There is, however, one feature of Professor Mulliken's book which, so far as we know, is new, and which might be made extremely useful. In a pocket in the back cover of the book are placed three cardboard sheets, containing a very carefully constructed color standard of nearly 150 different shades, most conveniently arranged for comparison and identification. This color standard is constantly referred to, in the book, and wherever possible every single one of all the many thousands of tests set down in the tables has the color reaction carefully and accurately classified to correspond to its place in the standard.

This suggests an idea which might be developed into a treatise on modern dyestuffs, which would be of real interest and value to dyeing chemists all over the world. The difficulty with "Schultz & Julius," and with "Knecht, Rawson and Loewenthal," is that they do not give sample dyeings of the colors they describe, and so must be supplemented, for practical use, by collections of sample cards of the great dyehouses, or by home-made collections of dyed samples, carefully noted and indexed, in order to get a good idea of the color produced by each dyestuff.

On the other hand, Lehne's large and valuable book, published in 1893, containing dyed and printed samples of the colors described in the last Schultz & Julius catalogue of that time, was so exceedingly difficult and expensive to prepare that it has proved impossible to keep it up to date.

But, by using these very excellent color

standards of the Milton Bradley Co., as contained in this book of Professor Mulliken's, it would be possible to accurately describe and identify the exact shade of the characteristic sample dyeings, without pasting a single sample in the book. And, by a proper system of classification, the chemist attempting to identify a color, after determining its class, and dyeing a sample, would determine its exact place in the color table, and so avoid the necessity of hunting it up in the sample books of the different color houses, or in his own sets of home-made samples.

To be of real value, such a treatise should be written by a well-trained color chemist, thoroughly familiar with the dyestuffs of today, from their practical side, and accustomed to face, in his regular work, the many and varied problems in textiles, paper-making, pigments, food products and the like, which appear every day in a large dyeing laboratory.

The theoretical part of such a book could be easily obtained from the treatises we have at present, including this one of Professor Mulliken's. But the use of the color standard would give opportunity for identifying the shades with a minimum of trouble and expense; and if the writer would incorporate some of the regular laboratory information about methods, and about the practical peculiarities of the different dyestuffs, their ease of dyeing, comparative fastness, special uses, cost prices as compared to others of the same or different classes, and a host of other minor matters of practical interest to users and workers with the dyestuffs, such a book would be hailed with enthusiasm by dyeing chemists from one end of the world to the other.

CHARLES E. PELLEW

October 5, 1910

SCIENTIFIC JOURNALS AND ARTICLES

THE contents of the *American Journal of Mathematics* for October are:

"*q*-Difference Equations," by Rev. F. H. Jackson.

"On the Relation between the Sum-formulas of Hölder and Cesàro," by Walter B. Ford.

"Sur un Exemple de Fonction Analytique Partout Continue," par D. Pompeiu.

"Symmetric Binary Forms and Involutions," by Arthur B. Coble.

"Systems of Tautochrones in a General Field of Force," by Harry Wilfred Reddick.

"The General Transformation Theory of Differential Elements," by Edward Kasner.

BOTANICAL NOTES

TWO RECENT BOOKS ON LICHENS

WITHIN a few weeks of each other two notable contributions to our knowledge of the lichens of this country have been issued. The first is Albert W. C. T. Herre's "Lichens Flora of the Santa Cruz Peninsula, California," published in the *Proceedings of the Washington Academy of Sciences* (Vol. XII., No. 2) and bearing date of May 15, 1910; while the second is Bruce Fink's "Lichens of Minnesota" published in the Contributions from the United States National Herbarium (Vol. 14, Part 1) and bearing date of June 1, 1910. The first contains 243 pages, and the second 256 pages, with 51 plates and 18 text-figures. They are both nominally local lichen floras, and judged by their titles alone might be supposed to present a similar mode of treatment. However a comparative examination of the two works shows a marked difference between them. Thus while both accept Zahlbruckner's general understanding of the lichens, the first author proceeds at once to the descriptive part of his book, evidently assuming that the reader will bring to its perusal all the necessary knowledge for its full understanding. In Professor Fink's book, on the contrary, there is an explanatory introduction in which there is a discussion of the nature of lichens, and the views that have prevailed during the past two centuries. This is followed by a particular discussion of what is known of their structure and reproduction, including under the latter sexual reproduction. Here he says "the sexual processes have not been studied in very many of the fungi most closely related to the lichens, but recent discoveries seem to indicate that sexuality is common there and in the ascomycetous lichens as well. In Collema, Stahl and others have found that the apothecium is

preceded by an archicarp and a trichogyne which are supposed to constitute a reproductive tract. The more recent researches of Baur, Darbishire, Lindau and Wainio have proved the existence of similar tracts in lichens of several genera, and while there is yet much need of research regarding nuclear behavior, the general presence of sexual organs in lichens can scarcely be questioned longer."

It need scarcely be said that both authors accept the duality of the lichen's structure as no longer to be questioned, which reminds the writer of this review of the complete change of opinion in this regard that has taken place in the past thirty years. Then every American and practically every English lichenologist denounced the "algo-lichen hypothesis" as they styled it, as the height of foolishness, as well as the depth of stupidity. Now one wonders whether there are any botanists who regard lichens as autonomous in the old sense. Are there any who deny that the "gonidia" are algæ? Where are they who so vehemently denounced Schwendener and his little band of followers? Here we have a professed lichenologist uttering such words as these: "Whatever may be the outcome of further study of this question, the conception . . . which is still held by some botanists, that the fungus and the alga together compose an organism or an association which constitutes the lichen need be abandoned before there can be any clear thinking regarding lichens. The lichen is the fungus of the association." In the old days this would have been regarded as a betrayal of lichenology, for logically it reduces all "lichens" to the category of fungi. In the old days the paragraph quoted would have brought down a storm of wrath upon the head of the author, but now no one notices this as at all out of the ordinary. *Tempora mutantur!*

In Mr. Herre's book 307 species and subspecies are described from a peninsula 90 miles long and including perhaps no more than 1,800 to 2,000 square miles, and ranging from sea level to a maximum elevation of 3,793 feet. In Professor Fink's book which covers an area more than forty times as large, the number of species and subspecies is 441. We have no means for comparing the treatment of species and lower groups by the two authors, but from "the face of the returns" as here given it appears that the Santa Cruz peninsula must be more than ordinarily rich in lichen forms.

Mr. Herre's book includes one new genus and eleven new species, certainly not a great number for such an area, or such a total number of forms. In Professor Fink's book we have been unable to find a single new species. These are encouraging signs. In some other departments of systematic botany two such books as these could have been depended upon to yield from 50 to 100 new species at the very least!

In both books all specific names are decapitalized. Professor Fink's book is richly illustrated by 52 plates (mostly reproductions of photographs) and 18 text figures. Some of these are exceptionally fine.

THREE PATHOLOGICAL BOOKS

It is not so very long since there were no plant pathologists in the United States. At least there were none known by that name. There were a few botanists who began to realize that plants were subject to diseases, but the United States Department of Agriculture had as yet given no attention to the subject, and this was before the inception of the experiment stations. At one time several botanists united in a memorial to the Department of Agriculture calling attention to the desirability of beginning work in plant pathology, and what was their astonishment when the secretary very promptly appointed Professor Scribner, until then a student of the grasses, to be the pathologist. And no one was more astonished than the professor himself, but at that time secretaries of agriculture knew little or nothing as to the qualifications of a pathologist. And it is greatly to the credit of the graminologist so suddenly torn from his chosen speciality and thrust into a new field, that he started the work in a creditable manner, and laid a good founda-

tion for the excellent work that for many years has been done in the department.

These thoughts are suggested by the fact that there lie before the writer three notable recent books on plant diseases, by American authors. They are Duggar's "Fungous Diseases of Plants" (Ginn), Selby's "Handbook of the Diseases of Cultivated Plants in Ohio" (Ohio Expt. Stn.), and Stevens and Hall's "Diseases of Economic Plants" (Macmillan). The first of these treats the subject from the standpoint of the parasite, so that in it the student of the fungi may learn what injury, if any, is wrought by any fungus, or group of fungi. Two hundred and forty illustrations, many reproductions of photographs, help to make the text clearer for the beginner. A "host index" brings together the various parasites that affect particular hosts.

The second book is a revision and enlargement of a most useful bulletin (121) issued several years ago. In it, after an introduction treating of plant diseases in general, the subject is treated from the standpoint of the hosts alphabetically arranged. Thus we have alder diseases, alfalfa diseases, apple diseases, and so on throughout the alphabet, to watermelon and wheat diseases. Good illustrations (105) are scattered through the text.

The last book to appear is the result of many years of work by the senior author. Here the treatment is from the standpoint of the hosts, but instead of taking these up in a simple alphabetical order, they are alphabetically arranged under certain general heads, as pomaceous fruits, drupaceous fruits, small fruits, tropical fruits, vegetable and field crops, cereals, forage crops, fiber plants, trees and timber and ornamental plants. More than two hundred text figures add greatly to the usefulness of the book. Some of these are exceptionally fine reproductions of photographs.

American botanists are to be congratulated upon the publication of these three books. They will serve as most valuable helps in introducing students to the outlines of plant pathology. Selby's book is the most "popular" and will be most easily understood by farmers, and general students; Stevens and Hall's book also will be quite easily understood, especially by farmers of some botanical education. Its classified host arrangement will prove especially helpful to this class of readers, and will appeal to many students also. Duggar's book is especially a mycologist's book, since the fungous parasites are taken up in their natural sequence. It is the most technical of the three books, and for that reason will appeal most strongly to the teacher and student who approach the subject from the mycological rather than from the agricultural or horticultural side.

POISONOUS PLANTS

Professor Doctor Pammel has brought out a most useful book under the title of "A Manual of Poisonous Plants" (Torch Press, Cedar Rapids, Iowa). After a general discussion of the nature and action of poisons the author presents a systematic catalogue of the plants that are poisonous, beginning with the bacteria and blue-green algae, and running up through the flowering plants. The illustrations, of which there are a hundred or more, will prove helpful, especially for the non-botanical reader. The book will be useful to physicians and medical students, as well as to farmers who may wish a guide as to the nature of many of the plants about them, while it will be interesting and helpful to the general botanist also.

A NEW MUSHROOM BOOK

A new type of mushroom book has just been brought out by Professor Doctor Clements under the title of "Minnesota Mushrooms." It is the fourth of a series of popular guides to the plants of Minnesota to appear in the well-known Minnesota Plant Studies, and is designed for the use of classes in the high schools, and as a guide to make available the edible species by distinguishing them with certainty from those which are harmful. Copies of the book "are furnished free to citizens of Minnesota upon request" and "ten copies are sent free to each high school, academy, or college within the state." Certainly

the inhabitants of Minnesota ought not to be in ignorance hereafter as to the mushroom species of that state.

The book opens with an introductory page of generalities regarding fungi, among which we are glad to find that the Roman pronunciation of the Latin names of families, genera and species is given as the proper one to be used. Then follows keys and descriptions, accompanied by 124 reproductions of photographs. The attempt has been made by the author to write his descriptions in such non-technical language as will render them intelligible to the reader who is not an expert in mycology. Even the non-botanical reader will be able to master the necessary terms by referring to the glossary at the end of the volume. Four color plates add to the interest of the book. The last chapter deals with collecting and cooking mushrooms. Enough advice is given here to prevent any danger from the use of poisonous species, and there are enough recipes to start out the neophyte mycophagist happily and safely.

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THE SCIENTIFIC RESULTS OF THE FIRST CRUISE OF THE "CARNEGIE" IN MAGNETISM, ELECTRICITY, ATMOSPHERIC REFRACTION AND GRAVITY[1]

THE first cruise of the *Carnegie* began at Brooklyn in August, 1909, and ended at the same place in February of the present year. During this period of about six months, a total distance of 8,000 nautical miles was covered in the north Atlantic Ocean between the parallels 51° north and 19° north and the following ports were visited: Greenport (Long Island), St. John's (Newfoundland), Falmouth (England), Funchal (Madeira), Hamilton (Bermuda) and Brooklyn (New York). Last June the vessel started out once more, this time on a circumnavigation cruise of 65,000 miles to extend over a period of three years and to embrace the Atlantic, Indian and Pacific Oceans. The vessel has already completed a voyage of nearly 7,000 miles since she left last June and is now at the mouth of the Amazon River. The present voyage has not only cut across our first cruise, but is so arranged, by the introduction of loops, as to intersect itself also at various points. We are thus enabled to apply numerous checks.

In addition, special observations have been made in Gardiner's Bay, off Long Island, and on the neighboring islands at the beginning of the first cruise in September, 1909, and again at the beginning of the present cruise in June of this year. The results of all these elaborate tests have shown conclusively that, with a non-magnetic vessel like the *Carnegie* and with the instrumental appliances and methods used, it is possible to secure an accuracy in the magnetic results approaching that of land observations.

As I am to cover four lines of activity on this vessel in the space of a quarter of an hour, it will not be possible to go into further detail and I shall have to content myself with stating at once the main conclusions reached.

A. *Terrestrial Magnetism.*—Except for the portion of the cruise from 48°.5 N., 47° W. to Falmouth Bay and thence to Madeira, all charts show too low west magnetic declination over the portion of the Atlantic Ocean covered by the *Carnegie*. While the correction is in general less than a degree, it is unfortunately in the same direction for about 5,000 miles, and hence the resulting error in a ship's course based on the present mariner's charts may be accumulative and ultimately reach a considerable amount. The maximum chart error at any one point may be from 1°.3 to 2°.6 according to the chart used.

The chart corrections both for magnetic inclination and horizontal intensity, often being of opposite signs on the portion of the *Carnegie's* first cruise, the average algebraic correction is in consequence at times greatly reduced. The average chart correction (sign not being considered) for magnetic dip approximates 1°.5 to 2°; the maximum correction for the British chart is 2°.5 and that of the German 4°.4. It is also seen from the values of the average algebraic dip correction,

[1] Read at the meeting of the American Physical Society, New York, October 15, 1910.

that the British chart gives, in general, too small dips and the German too large ones. The average chart corrections for magnetic horizontal intensity, disregarding sign, approximate 8 units of the third decimal C.G.S.; the maximum correction is about 15 units for either chart. For the greater part, both charts give, in general, too high values.

The observations received from the present cruise down to Porto Rico, which are already in my office, and the cable dispatch received from Mr. Peters, in command of the *Carnegie*, when he arrived at the mouth of the Amazon on September 24, prove that the results of the first cruise are being borne out by the present one. The *Carnegie* left Para on the fifteenth instant to continue her journey down the South American coast as far as Buenos Aires, from thence she will cross to Cape Town, arriving there towards the end of March, 1911, where the speaker expects to join her. The present cruise will cover the Atlantic, Indian and Pacific Oceans, will have an aggregate length of about 65,000 miles and will terminate at Brooklyn about July 1, 1913.

B. *Atmospheric Electricity.*—Observations for specific conductivity of the atmosphere, with a Gerdien conductivity apparatus, and the detection of the presence of radio-active emanations, using an apparatus of the Elster and Geitel type, were taken on the *Carnegie* by Mr. Edward Kidson on the portions of the cruise between Falmouth and Madeira and Bermuda, and Bermuda and New York. The plan was to devote alternate days to conductivity and radio-activity observations. This program was interfered with by bad weather and by the failure on some occasions of the Zamboni dry pile which was used to charge the collecting wire in the radio-activity experiments.

From the observations obtained, no connection could be established between atmospheric pressure, humidity, wind or cloud and the conductivity. When, however, there was a visible fog or haze the conductivity was greatly reduced. Rain squalls of short duration did not produce any effect. As the conductivity is an extremely variable quantity, a very large number of observations is required before the connection with meteorological conditions can be thoroughly investigated. One effect that was noticed was that a low conductivity was invariably obtained when the vessel was in the neighborhood of land. This effect was heightened in Long Island Sound on the vessel's return in winter by the state of the atmosphere then prevailing and probably by the presence of snow on the land and ice on some stretches of water.

Another noticeable fact was the persistent excess of the positive conductivity over the negative. The only occasions on which the reverse appeared to be consistently the case were while the ship was at anchor off Madeira and in Hamilton Harbor, Bermuda. This higher value of the positive conductivity is probably due chiefly to the accumulation of positive ions near the negatively charged earth's surface. If this were so, then the effect should not be so noticeable in balloon observations, as believed to be the case.

None of the present theories seem sufficient to explain the high degree of ionization observed in the air.

On December 18–19 continuous observations of the conductivity were taken over practically twenty-four hours, in order to discover, if possible, a diurnal variation. The day was exceedingly calm and fine, with a glassy sea with a smooth, low swell. The results point to a higher value of the conductivity at night than during the day, and to an almost constant value at night. This latter effect is more obvious if the individual observations be all plotted, when the variations are seen to be much greater and more irregular during the day time. It would be interesting to secure more of these continuous observations.

The chief results of the observations for the detection of radio-active matter in the atmosphere are as follows: The evidence thus far gathered points to the absence of any considerable quantity of thorium emanation in the air over the ocean, however, more observations are needed to decide the question definitely. On several days, when the vessel was very far

from land, very little activity was collected; particularly was this the case on December 11, 14 and 18. The region in which this happened was a very calm one, and the air had probably not been in contact with the land for many days. Mr. Kidson is inclined to think, therefore, that the land is the chief source of the radio-active matter in sea air. This is what would be expected from determinations of the radium content of sea water. The fact that Mr. P. H. Dike, the observer on the *Galilee* in the Pacific, could obtain no evidence of radio-activity except near land, also points to this conclusion. The Pacific Ocean being of so much greater extent than the Atlantic, there should be much larger tracts over which the air had lost any radio-activity got from the land. The absence of thorium emanation would tend to confirm this theory.

It is easy to understand that the air in the North Atlantic between Newfoundland and England may at times have all been over land surfaces within a week. This may account for the results obtained by Professor Eve in this region.[2] Observations comparing the amounts of radio-activity over land and ocean are much needed.

C. *Atmospheric Refraction Observations.*—These observations consisted in the determination of the "dip of the horizon," being made for the purpose of controlling the corrections to be applied to the astronomical observations on account of atmospheric refraction. The observer was J. P. Ault, the navigating officer on the first cruise, Pulfrich's dip measurer, made by Zeiss, being used, in which, by the aid of prisms, the two horizons to the right and to the left are seen as two parallel vertical lines in the field of view of the small telescope, the distance apart of the lines being equal to twice the angular value of the dip of the horizon, read off in minutes by means of a scale.

The corrections found on the values obtained from atmospheric refraction tables were, in general, negative, reaching a maximum of $-1'.02$, showing the tabular value to be too large, however, on the portion of the cruise between Bermuda and New York the corrections in the mean are positive, the maximum being $+1'.23$. The dip of the horizon being a correction which is applied directly to an observed altitude of a celestial body, if then in case the latitude is obtained from meridian altitudes it would be in error by the same amount as the dip correction, hence in the maximum $1\frac{1}{4}$ of a minute of arc or of a nautical mile, or nearly $1\frac{1}{2}$ statute miles. The error in longitude will vary from one minute to over three minutes of arc, allowing a celestial body an azimuth of over thirty-five degrees from the meridian and for a range in latitude from twenty degrees north to fifty degrees north; for extreme conditions the error may even be greater.

It is thus seen that it is highly desirable for the mariner to have accurate tables of atmospheric refraction, especially near land, where an error of a mile or two in the ship's position is a matter of grave importance. In fact our attention to the need of such observations was first called by mariners themselves, who have found at various times when nearing the coast, where the opportunity was afforded to check their astronomical positions by land objects, that their positions were out presumably due to the tabular values of atmospheric refraction. How far the refraction corrections may depend upon prevailing meteorological conditions must be left for future examinations when additional data are at hand.

D. *Gravity Observations.*—Suggestions have been received from various sources that it would be highly desirable to include, if possible, gravity work on the *Carnegie*. In 1905 I consulted Professor Helmert, director of the Geodetic Institute at Potsdam, as to the possibility of attempting such work on the *Galilee,* which at the time was chartered, as may be recalled, for the magnetic work in the Pacific Ocean. One of his assistants, Dr. Hecker, had employed the method of getting gravity results at sea by determining the temperature of the boiling point of water, deducing therefrom the corresponding atmospheric pressure and comparing this with the observed mercur-

[2] A. S. Eve, "Terr. Mag.," v. 15, 1909 (25).

ial barometric height referred to normal gravity, the outstanding difference being the measure of the gravity anomalies within the inevitable observational errors. He had made a cruise on a passenger steamer in 1901 from Hamburg to Rio de Janeiro and back to Lisbon; again in 1904 he made further cruises in the Indian and Pacific oceans and in 1909 also in the Black Sea. As the result of Hecker's experiences, Professor Helmert did not think it possible to get anything of value on such a small vessel as the *Galilee,* and we accordingly made no attempt.

However, on the *Carnegie,* it was decided to make as frequently as possible determinations of the temperature of the boiling point of water with the prime view of obtaining the data required for controlling the corrections of our aneroids. The instrumental equipment was in accordance with this chief purpose, and hence only two boiling point apparatuses, furnished each with a thermometer, and an ordinary Green marine mercurial barometer, were provided. In all one hundred and two determinations were made, representing seventy-five different points, four of which were the ports Brooklyn, Falmouth, Madeira and Bermuda. It should be said that the observer, Dr. C. C. Craft, had no idea of the possible use of his results for gravity; however, a very searching examination has convinced me that with the necessary refinement in instrumental equipment and in method of observation it will be possible to obtain gravity results on the *Carnegie* worth while. While the results on the first cruise can not be used for determining the gravity anomaly over any restricted area, a general deduction can be drawn, in view of the large number of observations and the varying conditions under which they were made, which harmonizes with the general conclusion of Hecker's work, namely, that gravity is in general normal over the deep oceans, the defect in the density of the aqueous material above the ocean bottom being made up very nearly by increased density of the material below the ocean bottom. If we average our results then the mean anomaly over the deep part of the Atlantic Ocean, three to seven kilometers, differs from the mean over the shallow part along the coasts, five to two hundred meters, by about $+0.04$ of a dyne, meaning that there is a slight defect in gravitational force over the deep ocean by that amount as compared with the force over shallow water. This is to be regarded merely as a provisional result, the indication being that the final reduction may diminish the quantity to $+0.03$ or even to $+0.02$ dyne. Our result is in the same direction as Hecker's conclusions, he getting figures on the order of $+0.02$ to $+0.055$ of a dyne. A difference of .035 of a dyne would correspond approximately to an error of 0.001 of a degree in the temperature of the boiling point of water. The average difference in the temperatures of the boiling point for the two thermometers used and for a single determination was 0.003 of a degree; the average result above depends upon 75 stations. In his latest work Hecker employed nine specially constructed mercurial barometers and six thermometers and six boiling point apparatuses.

In connection with this investigation I have had occasion to examine into the various tables for obtaining the atmospheric pressure corresponding to the temperature of the boiling point of water, the latest of these tables in general use being those of Wiebe's given in Landolt-Börnstein's "Physikalisch-Chemische Tabellen." The most recent observations appear to be those of Holborn and Henning. For the purposes of gravity work, it is essential to be able to obtain accurately the atmospheric pressure for a comparatively limited range extending below and above 100° C.; the observations on which the tables are based on observations at larger intervals and the interpolation is accordingly somewhat uncertain. It is quite possible that the atmospheric pressure as taken from the tables may be out .05 to 0.1 mm. which corresponds to 0.065 to 0.135 of a degree in gravity. When dealing with only differential results of gravity, as we are in the present instance, the tabular errors are somewhat eliminated, though not wholly. I desire to bring this problem of more accurate

vapor tension tables for water between 99° and 101° C. to the attention of physicists.

In conclusion, it should be emphasized that we propose to use the boiling point method only for getting *differential* results in gravity and not for absolute results. All necessary refinements are now to be introduced in the future work.

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SPECIAL ARTICLES

THE NATURE OF ELECTRIC DISCHARGE

AT a meeting of the Academy of Science of St. Louis, on October 17, the writer presented photographic plates which strongly confirm conclusions reached in former papers.[1] Pin-head terminals rest with their rounded heads upon the film of a photographic plate. Their distance from each other is about 7 cm. One terminal is grounded in the yard outside of the building. The other leads to a variable spark-gap at the negative terminal of an 8-plate influence machine, the positive terminal being grounded on a water-pipe. With very short spark-gaps, the passing of a single spark produces discharge images immediately around the pin-heads. Increasing the spark-length enlarges the images, which are in the nature of brush discharges. The negative glow around the pin-head which communicates with the negative terminal of the machine increases very little in diameter, and the discharge lines in it are radial. The discharge lines around the grounded pin-head for short sparks follow approximately the lines of force. With longer sparks they are somewhat distorted, as if beaten back by a blast from the opposite or negative terminal. As has been suggested in the papers referred to these discharge lines in the "positive column" are drainage lines, along which Franklin's fluid is being conducted into the positive or grounded terminal. The portions of the air molecules which constitute the stepping stones for the negative corpuscles are urged in a direction opposite to that in which the negative discharge is flowing, thus promoting the lengthening of the drainage lines. Many hundreds of plates have been exposed in an attempt to adjust the spark-gap so that these drainage lines would end just outside of the negative glow without reaching it. In this way the length of these lines may be gradually increased until they approach the dark space around the negative glow. This dark space is a region where convection of atoms which have been supercharged within the negative glow are urged by convection away from the negative terminal. If the drainage lines reach this convection region, they cross it and reach the negative glow. It has thus far been found impossible to have them end within this Faraday dark space. If the spark-gap at the machine is so adjusted that only one or two drainage lines reach the negative glow, these lines will unite end on with the radial discharge lines of the negative glow. At the same time there is a distortion in the lines at and near their union, which reveals the commotion produced by the opposing "electric winds."

If now the spark-gap at the machine be slightly increased, other drainage lines reach the negative glow. They cross its radial discharge lines, and even extend beyond the negative terminal. In a few cases the entire area of the negative glow is traversed by these drainage lines. It is evident that we have here the same conditions that Goldstein found in the vacuum tube. These drainage lines are the canal rays of the vacuum tube.

This explanation of the nature of electric discharge enables us to understand why the positive column in a vacuum tube follows the tube in all of its windings and bends. It is not a convection column, but a drainage column. It is a conduction column. The conditions are different from those in a copper wire, in that the parts of the atoms which constitute the conductor are in gaseous form, and are capable of yielding to the force which urges them in a direction opposite to that in which the negative corpuscles are being urged.

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[1] *Trans. Acad. of Sc. of St. Louis*, XIX., Nos. 1 and 4.